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ABSTRACT

This report is the 30th in a series that covers research and development (R&D) as shown in successive Presidential budgets. The Federal budget for 1982 was unusual in the extent to which it was subjected to change, reflecting the new administration's philosophy to reduce Federal spending. R&D funding data reflect the first series of 1981 and 1982 program reductions made by the new administration. Further reductions were proposed later in the budget cycle; these changes are shown by agency and discussed in the text of the report. The analysis also provides data on R&D program changes, 1981 to 1982, as indicated in the 1983 budget. The report is divided into four sections: (1) the 1982 budget; (2) Federal R&D funding by budget function; (3) the Department of Defense (DOD) share in Federal R&D funding; and (4) geographic distribution of funds, 1980. A feature of this report (section 3) is a special analysis of R&D funding trends for the DOD. The analysis extends back to the late fifties, but places particular emphasis on programs of the seventies and the strong defense buildup in the 1980-82 period. Impacts of the recent upsurge in defense R&D support are discussed in broad terms. (Author/JN)

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federal funds for research and development

fiscal years 1980, 1981, and 1982, volume xxx

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foreword

This report is the 30th in a series that covers R&D funding as shown in successive Presidential budgets. The Federal budget for 1982, on which this report and the preceding survey are based, was unusual in the extent to which it was subjected to change. The 1982 budget reflected the philosophy of a new administration, which sought, as part of a multifaceted economic revitalization program, to reduce substantially the rate of growth of Federal spending.

The survey of Federal agencies collected R&D funding data which reflected the first series of 1981 and 1982 program reductions made by the new administration. Further reductions were proposed later in the budget cycle; these changes are shown by agency and discussed in the text of the report. The analysis also provides data on R&D program changes, 1981 to 1982, as indicated in the 1983 budget. Since the budget continued to be amended even after the start of FY 1982, and since congressional actions resulted in modifications, a realistic presentation of ultimate budget outcomes had to await the compilation of FY 1982 R&D data in the next budget cycle.

A feature of this report is a special analysis of R&D funding trends for the Department of Defense. The analysis extends back to the late fifties, but places particular emphasis on programs of the seventies and the strong defense buildup in the 1980-82 period. Impacts of the recent upsurge in defense R&D support are discussed in broad terms.

John B. Slaughter
Director
National Science Foundation

April 1982

notes

The data for fiscal years 1980, 1981, and 1982, as shown in the detailed statistical tables, text tables, and most of the charts, were collected from Federal agencies in May through July 1981 and were based on agency budgets as incorporated in the President's 1982 budget to Congress, as revised in March 1981, but before further revisions were made in September and October.

The data are actual for 1980, but are estimated for 1981 and 1982. The 1981 data represent obligations estimated in the third quarter of fiscal year (FY) 1981 and reflect congressional appropriation actions through that period but *not* actions on requests for rescissions and/or supplemental requests. The data for 1982 are based on amounts proposed in the 1982 budget when it was first presented by the Reagan administration. Later budget revisions did not include detailed R&D analyses, but the September and October documents showing those revisions included sufficient information on broad R&D programs for estimates to be made of proposed R&D funding levels by agency, by functions, and in total. These are shown in some of the text tables and discussed.

Table and chart details may not add to totals because of rounding.

To obtain accurate historical data, use only the latest detailed statistical tables C-108 through C-121 for *Federal Funds*, Volume XXX (NSF 81-325), and not data published earlier. Agencies revise prior-year data when important changes occur in program classifications, and only the latest tables incorporate such changes. More complete historical data are provided in *Federal Funds for Research and Development: Detailed Historical Tables: Fiscal Years 1970-82*, available on request from the Division of Science Resources Studies, National Science Foundation.

acknowledgments

This report was prepared in the Division of Science Resources Studies under the general guidance of Charles E. Falk, Director, and William L. Stewart, Head, R&D Economic Studies Section. Eleanor H. Stoddard, Study Director, Government Studies Group, provided direction and was responsible for writing portions of the text. Joseph Geraci assisted in the analysis and wrote other portions of the text. Dorothy K. Ham prepared statistical materials and graphic illustrations.

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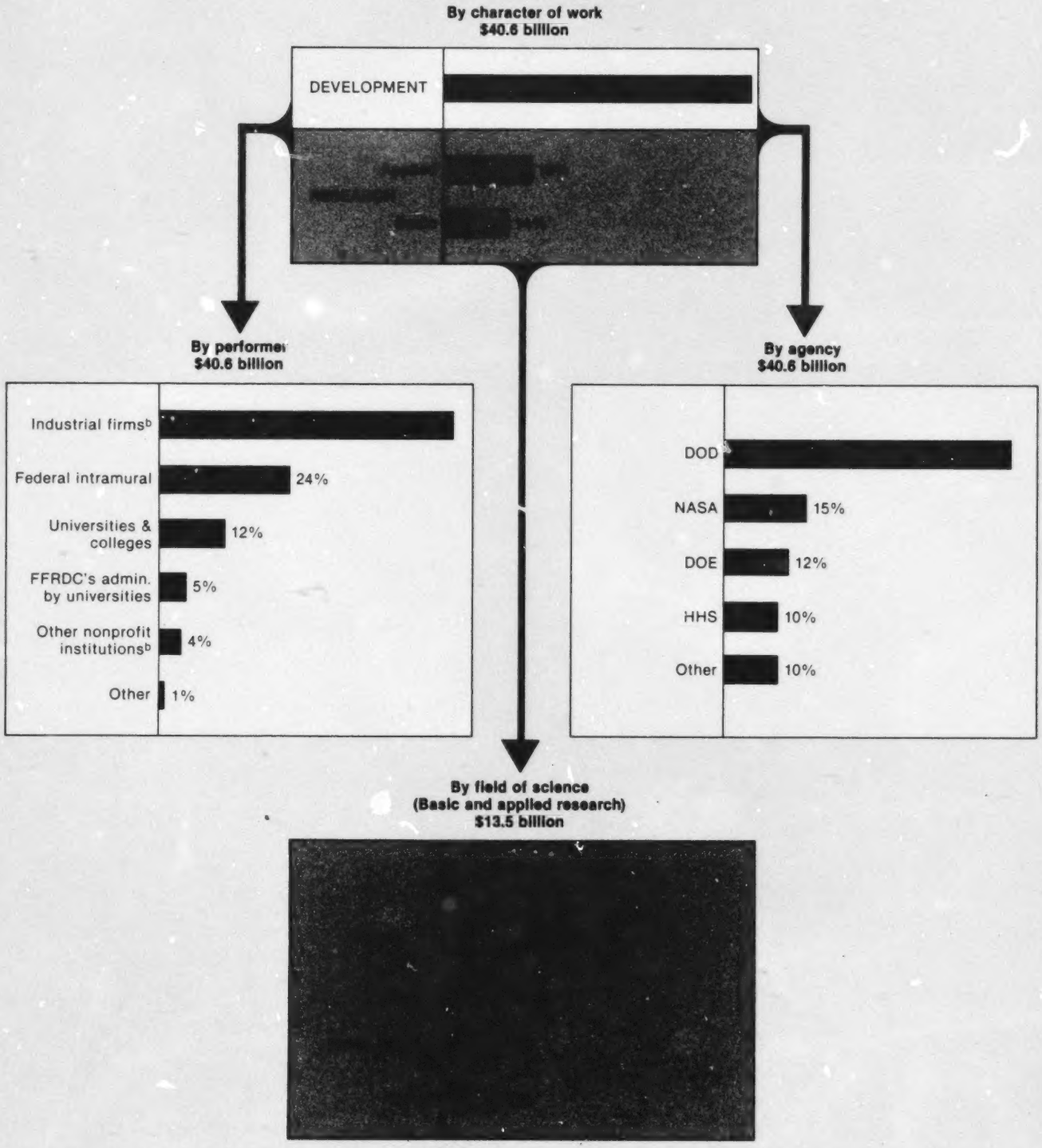
[1] See note on p. 41.

Distribution of Federal obligations for research and development: FY 1982 (est.)[a]



[a]These data are based on the President's 1982 budget to Congress as presented in March 1981. They exclude R&D plant data.

[b]Includes federally funded research and development centers (FFRDC's) administered by this sector.

SOURCE: National Science Foundation

highlights

- The 1982 Federal budget was revised several times as part of a wide-ranging effort by the administration to reduce the rate of growth of Government spending. As a result, the total of $40.6 billion in Federal R&D obligations (R&D plant excluded) in the March 1981 version of the budget was reduced by 7 percent to an estimated $37.7 billion six months later. Subsequent actions produced a somewhat higher estimated R&D total of $38.8 billion for FY 1982, or 11 percent more than FY 1981, which allowed for some real growth. Another gain of 11 percent over 1982 was anticipated in the 1983 budget.

- At every stage of the 1982 budget process, R&D funding for the Department of Defense (DOD) was given highest priority, while R&D programs of most other agencies were either reduced from 1981 levels or permitted only slight growth. An increase of 28 percent for DOD R&D programs in the March budget compared with an increase of 3 percent for all other agency R&D programs combined. In the 1983 budget, the indicated DOD increase, 1982 over 1981, was 25 percent, and all other R&D programs together were expected to decrease by 1 percent.

- National defense R&D budget authority as a share of total Federal R&D budget authority rose from 47 percent in 1980 to an estimated 57 percent in 1982 (latest data). This function consists of DOD programs and Department of Energy (DOE) atomic energy weapons programs.

- DOD R&D funding fell in real terms from 1967 to 1975 and increased only 1.6 percent per year in constant dollars from 1975 to 1980. A sharp reversal of this trend was shown in 1981 and 1982 in estimated real increases of 8 percent and 15 percent, respectively.

- DOD funding increases will have the most impact on Federal intramural R&D activities and R&D activities of industrial firms, especially in aircraft, aerospace, electronics, and computer fields. The fields of science most affected by DOD funding growth will be engineering, mathematics and computer sciences, and psychology. The impact on these fields will be felt especially in the case of basic research conducted in universities.

- At every stage, the National Aeronautics and Space Administration (NASA) was the only agency other than DOD where the R&D obligation level in 1982 was higher than in 1981. This higher level was due to high priority given to the space shuttle program.

- In the 1983 budget, DOE showed the greatest 1982 relative decrease among leading R&D support agencies—down 9 percent from the 1981 level. The decline was in line with an administration philosophy of encouraging the private sector to assume energy R&D programs that show promise of near-term commercialization.

- As a result of budget reductions, R&D and R&D plant outlays for 1981 and 1982 were expected to constitute 5 percent of total Federal budget outlays, compared with 6 percent in every year of the 1975-80 period.

- Basic research obligations for 1983 in the March 1981 budget were $5.6 billion; by the following year, they were shown at $5.3 billion, 5 percent more than in 1981, or a real decline of 3 percent.

introduction

This report is one of several recurring National Science Foundation (NSF) reports based on surveys that cover R&D activities within the major sectors of the national economy. The data in the *Federal Funds* series cover Federal agency support of R&D programs. In the current report, most data are based on R&D obligation levels as reported in the *Federal Funds for Research and Development, Fiscal Years 1980, 1981, and 1982,* Volume XXX, survey, conducted by NSF between May and July 1981. The 95 agency respondents, representing departments, agencies, and agency subdivisions, include all those that sponsored R&D programs during the 1980-82 budget period.

Federal agencies provided R&D data to the Office of Management and Budget (OMB) for inclusion in "Special Analysis K: Research and Development" in *The Budget of the United States Government, Fiscal Year 1982,* as part of the budget document presented to Congress in January 1981. The incoming administration, however, revised the 1982 budget as part of a broad anti-inflationary and economic revitalization program. In April, OMB issued "Research and Development Revisions to the Fiscal Years 1981 and 1982 Budgets, March 1981," which summarized proposed rescissions in FY 1981 R&D programs and budget amendments to FY 1982 R&D programs for leading R&D support agencies. The agencies, in reporting to the *Federal Funds* survey for fiscal years 1980, 1981, and 1982, incorporated these revisions. R&D data in the OMB document and in the *Federal Funds* survey were based on the same definitions and are reconcilable, but data in the *Federal Funds* survey are classified in greater detail and cover smaller R&D support agencies not covered by OMB.

The *Federal Funds* categories, as shown in this report and in detailed statistical tables, which were released earlier in a separate document,[2] cover Federal R&D data by agency, character of work (basic research, applied research, and development), performer, and field of science for the 1980-82 period and by State distribution for 1980. The detailed statistical tables, aside from providing detail, include historical data for the 1972-82 period.

Data in the detailed statistical tables for FY 1972 through FY 1980 are actual, but data for the next two years are tentative. Data for FY 1981 reflect obligations estimated in the third quarter of that year, including obligations carried over from prior-year appropriations, as reported by the agencies at that time; they also include rescissions to program levels proposed by the new administration in March 1981. Data for FY 1982 are based on amounts requested in the President's 1982 budget, as presented in March 1981; they do not reflect the later amendments to the 1982 budget proposed in September and October 1981.

This report departs somewhat from earlier reports in the *Federal Funds* series in that it includes estimated data based on the fall 1981 budget revisions and later data taken from "Special Analysis K: Research and Development" in the 1983 Federal budget. The reason for this departure from the reported R&D data based on the March 1981 budget was to include the later revisions of the administration's 1982 budget and their effects on R&D programs (insofar as it was possible to ascertain those effects). As a more settled stage of 1981 and 1982 R&D program levels was reached by early 1982, after congressional appropriation and executive apportionment actions had taken effect, the *Federal Funds,* Volume XXX, survey data were seen to reflect a fairly accurate picture of agency levels and year-to-year changes. The chief exceptions were overstatements of development funding for DOD and applied research funding for DOD and NASA.

Federal Funds data are comparable from one year to the next and provide a useful measure of trends. There are, however, classification problems in that some R&D programs are not clearly designated as such. When R&D programs are not identified as budget line items, they must be separated by agency respondents from other, larger programs in the agency budget accounts. Once identified, R&D programs must then be further subdivided into survey categories: basic research, applied research, development, performing sectors, and fields. They must also be identified in terms of distribution to States. Agency records are often kept by categories other than those requested in the survey, and in these instances, respondents must use judgment in reporting data.

The respondents have, however, gained considerable experience in meeting the survey requirements, and their efforts to report accurately and according to established definitions have continued to improve the reliability of the data. When reexamination of reporting systems has resulted in reclassification of data, agencies have revised prior-year data to maintain consistency. For this reason, users of historical data should use only the series in the latest detailed statistical tables or in the separate historical tables available on request from the NSF Division of Science Resources Studies.

[2] National Science Foundation, *Federal Funds for Research and Development, Fiscal Years 1980, 1981, and 1982,* Volume XXX (Detailed Statistical Tables) (NSF 81-325) (Washington, D.C., 1981). These are obtainable gratis from NSF.

section 1.

the 1982 budget

The 1982 Federal budget represented a substantial change in fiscal philosophy. A chief feature of this change was a sizeable reduction in the rate of growth of Federal spending. This, with a lowering of tax rates, the removal of some regulations considered excessive, a measured control of the money supply, and efforts toward a balanced budget were the components of the new administration's economic recovery plan.

budget history

As political and economic events unfolded during the year, the 1982 budget underwent a series of revisions almost until the 1983 budget was developed in final form. The Reagan economic program, which included a preliminary budget, was first presented to Congress on February 18, 1981. This was followed on March 10, 1981, by publication of a complete budget that cut the previous administration's 1982 proposed budget outlays by $44 billion.[3]

Congress responded by accepting most of the President's policy recommendations; those governing spending were embodied in the Omnibus Budget Reconciliation Act of 1981 (P.L. 97-35), which set authorization ceilings for specific programs and covered the entire discretionary budget. By the time this act was signed in August, however, economic forecasts indicated a growing budget deficit, despite the cuts, and the administration reacted by proposing an additional $26 billion in budget savings for 1982. These savings were to be achieved by a proposed pro rata 12-percent reduction in most discretionary (nonentitlement) programs—with the exception of defense programs, which were cut selectively rather than across the board.[4]

This time Congress did not accept all the administration's budget proposals. House Joint Resolution 357, making continuing appropriations for 1982, was passed by Congress on November 23, 1981, but was vetoed by the President because cuts from March levels were not large enough. House Joint Resolution 370 later effected a compromise and was signed into law on December 15, 1981 (P.L. 97-92). This law provided for continuing appropriations in 1982 of $4 million less than March overall levels but also provided for an additional cut of 4 percent from the base level for each agency, to be applied by OMB. Base levels were determined by already enacted legislation or by the levels recommended by the Senate Appropriations Committee (the House had already acted). The 4-percent cut applied to nondefense programs, but did not include entitlement programs and a few other excepted programs.

Immediately after enactment of P.L. 97-92, a number of appropriation acts applying to individual agencies and embodying these changes were passed and signed by the President. Exceptions were appropriations for the Departments of Labor, Health and Human Services, and Education; the Departments of Commerce, Justice, State, and the Judiciary; and Treasury, Postal Service, and General Government. These were funded under the continuing resolution until March 31, 1982 (and later under another continuing resolution covering the period from March 31 to September 30, 1982).

The 1982 budget, embodying fundamental changes in the role of Government spending and taxing policies, was the most extensively revised budget in recent history. Although in past years, budget amendments have been requested by every administration, the 1982 budget was unique in that it called for numerous amendments affecting almost all discretionary programs. Unusual aspects of this budget were the acceptance by Congress of almost all of the administration's initial proposals and the broad 4-percent reduction compromise between the administration and Congress which followed in December. Although congressional committees considered and acted on each appropriation account, budget decisions were strongly influenced by a widely recognized need for spending reductions.

[3] Executive Office of the President, Office of Management and Budget, *Fiscal Year 1982 Budget Revisions, March 1981* (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1981).

[4] House Document No. 97-94, *Budget Amendments, Fiscal Year 1982*, September 30, 1981, and House Document No. 97-101, *Budget Amendment*, October 15, 1981 (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1981).

federal r&d levels

The R&D portion of the 1982 Reagan budget was measurable at two points in the budget structuring process. The first was immediately after the overall budget was presented in March. OMB issued an analysis of R&D programs in the budget in April and, from May through July 1981, the agencies reported R&D data by detailed categories to the National Science Foundation (NSF) survey, *Federal Funds for Research and Development, Fiscal Years 1980, 1981, and 1982*, Volume XXX. These data, based on previous reporting of R&D program data by the agencies to OMB, are available in detailed statistical tables issued by NSF.[5]

The second point at which R&D program levels could be measured was in October, following the issuance of two documents by OMB, one covering proposed reductions in the discretionary nondefense portion of the budget and the other covering changes in defense accounts from earlier levels in March.[6]

By reference to the OMB documents, NSF was able to estimate the effects of the September-October proposed budget cuts on R&D programs (table 1). In some cases, the budget accounts were entirely, or almost entirely, R&D accounts, and dollar reductions could be fairly precisely obtained, especially in the case of the DOD, NASA, the National Institutes of Health (NIH), and NSF. In other cases, the amount of reduction in the R&D portions of agency budgets was not obtainable, and an arbitrary 12-percent reduction from March R&D levels was applied.

The $37.7 billion R&D obligation total thus derived for 1982 was 7 percent lower than the March total of $40.6 billion. Whereas the anticipated increase in total Federal R&D obligations in 1982 over 1981 had been 15 percent in March (table 1), the anticipated increase was now 7 percent, or less than the rate of inflation.

The final budget, developed through a process of negotiation between the administration and Congress, was settled on in December. Final R&D levels were higher than those proposed in the September-October documents. The effects of the agreements between the administration and Congress are seen in data provided by the agencies to OMB for the 1983 budget. This budget included an estimated Federal R&D obligation total for 1982 of $38.8 billion, 11 percent higher than the 1981 level. The "final" amount for 1982 was lower than the March estimate, but higher than the October estimate.[7]

The data provided in the 1983 budget revealed that most R&D levels shown in the first Reagan budget for 1982 (March) were closer to ultimate outcomes than the September/October data. The greatest change was in a $1 billion reduction in DOD 1982 R&D programs, producing a 25-percent increase for DOD in 1982 over 1981 instead of the 28-percent R&D increase planned earlier. Other agencies also

[5] See National Science Foundation, *Federal Funds for Research and Development, Fiscal Years 1980, 1981, and 1982, Volume XXX* (Detailed Statistical Tables) (NSF 81-325), Washington, D.C., 1981.

Table 1. Comparison of R&D obligations by agency in three versions of the 1982 Federal budget

[Dollars in millions]

Agency	March 1981[1]					Sept/Oct 1981[2]		February 1982[3]	
	1980 actual	1981 estimate	Percent change 1980-81	1982 estimate	Percent change 1981-82	1982 estimate	Percent change 1981-82	1982 estimate	Percent change 1982-82
Total	$31,680	$35,360	+11.6%	$40,602	+14.8%	$37,721	+6.7%	$38,843	+10.9%
Department of Defense	13,981	16,864	+20.6	21,523	+27.6	20,520	+21.7	20,553	+24.6
National Aeronautics and Space Administration	5,084	5,408	+6.4	6,017	+11.3	5,675	+4.9	5,841	+8.0
Department of Energy	4,754	4,927	+3.6	4,690	-4.8	4,169	-15.4	4,522	-8.6
Department of Health and Human Services	3,780	3,905	+3.3	4,169	+6.8	3,670	-6.0	3,972	(*)
National Science Foundation	882	937	+6.3	1,000	+6.7	880	-6.2	961	-.3
Department of Agriculture	688	770	+12.0	860	+11.7	757	-1.7	807	+4.3
Department of Transportation	361	399	+10.6	404	+1.1	344	-13.8	329	-21.7
Department of the Interior	411	423	+2.8	398	-5.9	351	-15.6	397	-6.6
Environmental Protection Agency	345	363	+5.2	303	-16.7	266	-26.6	317	-2.6
Department of Commerce	343	337	-1.7	288	-14.5	244	-27.4	271	-17.3
Nuclear Regulatory Commission	183	208	+13.7	225	+8.1	204	-1.9	223	-2.0
All other agencies	868	819	-5.6	725	-11.5	641	-21.7	650	-13.1

[1] Data are taken from *Federal Funds for Research and Development, Fiscal Years 1980, 1981, and 1982*, Volume XXX (Detailed Statistical Tables) (NSF 81-325).

[2] Data are based on *Budget Amendment, Fiscal Year 1982* prepared by the Executive Office of the President, *House Document 97-94*, September 30, 1981 and *House Document 97-101*, October 15, 1981.

[3] Data are taken from Office of Management and Budget, "Special Analysis K: Research and Development," *The Budget of the United States Government, Fiscal Year 1983*. Data for 1981, not shown, differ slightly from 1981 data shown in this table.

[*] Less than .05 percent.

SOURCE: National Science Foundation

[6] House Documents 97-94 and 97-101, *op. cit.*

[7] See Executive Office of the President, Office of Management and Budget, "Special Analysis K: Research and Development," *The Budget of the United States Government 1983, February 1982* (Washington, D.C.: Supt. of Documents, U.S. Government Printing Office, 1982).

received reductions, but these were less than those estimated in September. In the 1983 budget NASA showed an increase of 8 percent in 1982 over 1981 and DOE, a decrease of 9 percent. The Department of Health and Human Services (HHS) and NSF both showed virtually level funding. The Department of Agriculture (USDA) showed a 4-percent increase.

As might be expected, the share of R&D and R&D plant outlays within the 1982 Federal budget outlay total rose somewhat from the fall estimate—from 5.2 percent in the September budget to 5.4 percent in the 1983 budget. From 1975 until 1982 (March), the R&D share within the overall budget rounded to 6 percent in nearly all years, but with the later 1982 budget revisions, the rounded share is now 5 percent (table 2).

character of work

The Federal budget for 1983 showed a 3-percent constant-dollar increase in 1982 R&D obligations over 1981, one-half the anticipated increase in the 1982 budget presented in March 1981 (chart 1). Total Federal basic research and applied research levels, however, were expected to show real decreases from 1981, compared with slight real increases anticipated in the March budget.

The change for basic research was less than for applied research where cuts in DOD and NASA programs from March levels were largely instrumental in producing a greater relative reduction in the Federal applied research total. Despite a substantial cut in DOD development funding between the two periods, a real increase in total Federal development was still expected in 1982.

Table 2. Federal overall budget outlays and R&D obligations and outlays: fiscal years 1960-82

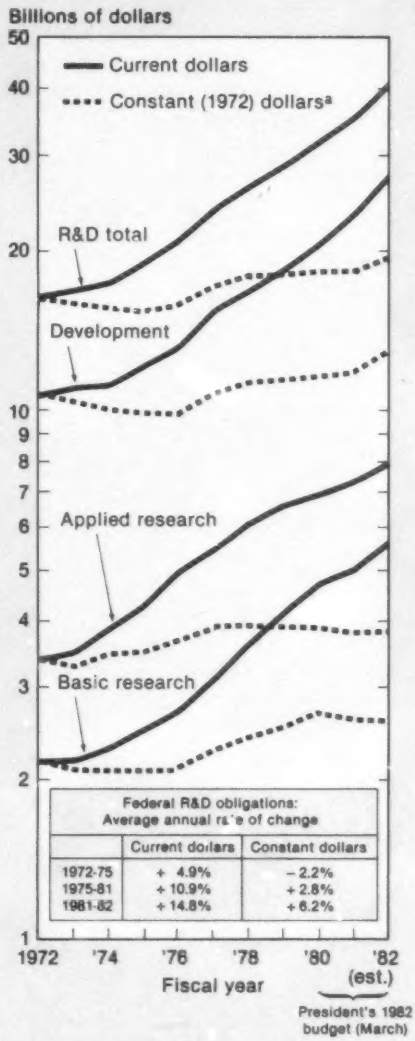
[Dollars in millions]

Fiscal year	Total budget outlays[1]	Research, development, and R&D plant		R&D & R&D plant outlays as a percent of total budget outlays
		Obligations	Outlays	
1960	$ 92,223	$ 8,080	$ 7,744	8.4
1961	97,795	9,607	9,287	9.5
1962	106,813	11,069	10,387	9.7
1963	111,311	13,663	12,012	10.8
1964	118,584	15,324	14,707	12.4
1965	118,430	15,746	14,889	12.6
1966	134,652	16,179	16,018	11.9
1967	157,608	17,149	16,859	10.7
1968	178,134	16,525	17,049	9.6
1969	184,645	16,310	16,348	8.9
1970	195,652	15,863	15,734	8.0
1971	210,172	16,154	15,971	7.6
1972	230,681	17,098	16,727	7.3
1973	245,647	17,574	17,489	7.1
1974	267,912	18,176	18,297	6.8
1975	324,245	19,860	19,551	6.0
1976	364,473	21,616	21,021	5.8
1977	400,506	25,350	23,379	5.8
1978	448,368	27,683	25,679	5.7
1979	490,997	30,453	27,842	5.7
1980	576,675	33,236	31,882	5.5
1981 (est. in March)[2]	655,200	37,026	35,277	5.4
1982 (est. in March)[2]	695,300	42,017	39,762	5.7
1981 (est. in Sept/Oct)[3]	660,500	37,026	35,277	5.3
1982 (est. in Sept/Oct)[3]	709,300	39,135	36,881	5.2
1981[4]	657,204	36,512	35,879	5.5
1982 estimate[4]	725,331	40,369	39,127	5.4

[1] Outlays include expenditures plus net lending.
[2] R&D data taken from **Federal Funds**, Volume XXX survey.
[3] Estimates based on *House Document 97-94, Budget Amendment, Fiscal Year 1982*, September 30, 1981, and *House Document 97-101*, October 15, 1981.
[4] Data based on the 1983 Federal budget.

SOURCES: Office of Mangement and Budget and National Science Foundation

Chart 1. Trends in Federal R&D obligations
(Semilog scale)



[a] Based on the GNP implicit price deflator for 1972-81 with an estimate of 8.2 percent for inflation in fiscal year 1982.
SOURCE: National Science Foundation

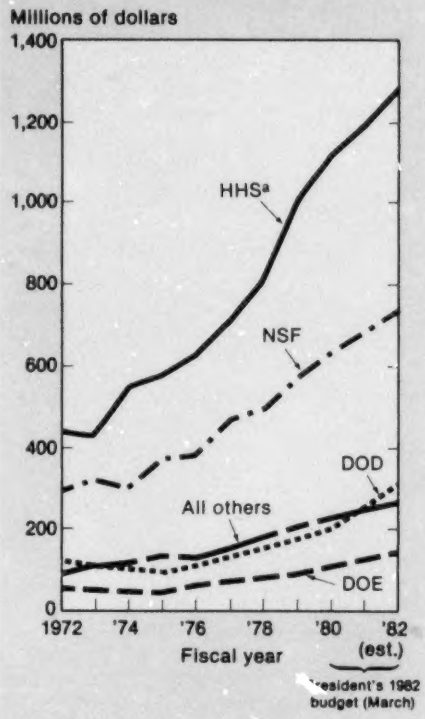
basic research

After growing each year in real terms between 1976 and 1980 (an average annual increase of 5.9 percent), Federal obligations for basic research now showed a real decrease of 1 percent in 1981 and a further real decrease of 3 percent in 1982 (based on 1983 budget data). Basic research obligations now represented 14 percent of the Federal R&D obligation total in 1982 versus 15 percent in 1980 (table 3).

The leading agencies in support of basic research are HHS, NSF, DOD, DOE, and NASA, in that order. As recently as 1978, DOD was in fifth place. In the 1982 budget HHS accounted for 36 percent of the basic research total, NSF for 17 percent, and DOD for 13 percent. One-half of all basic research obligations was expected to be directed to universities and colleges and one-quarter to Federal intramural activities.

Of the university and college performance total, 46 percent was expected to be supported by HHS (mostly NIH), 27 percent by NSF, and 11 percent by DOD. Although DOD funds directed to basic research projects conducted in universities have increased in recent years, the DOD share of all Federal basic research obligations to the academic sector has not grown substantially (chart 2).

Chart 2. Federal obligations for basic research to universities and colleges by agency



[a]Data have been adjusted to reflect only health and human services programs (without education).
SOURCE: National Science Foundation

Table 3. Federal obligations for research and development by character of work: fiscal years 1972-82

[Dollars in millions]

Fiscal year	Total	Research		Development
		Basic	Applied	
1972	$16,496	$2,165	$3,426	$10,905
1973	16,800	2,193	3,454	11,154
1974	17,411	2,339	3,877	11,195
1975	19,039	2,563	4,305	12,198
1976	20,780	2,700	4,915	13,165
1977	23,984	3,191	5,413	15,380
1978	26,388	3,619	6,105	16,663
1979	28,978	4,097	6,576	18,305
1980	31,680	4,688	6,909	20,083
1981 (est.)[1]	36,360	5,037	7,323	23,001
1982 (est.)[1]	40,602	5,551	7,983	27,068
1981[2]	35,033	5,108	7,217	22,708
1982 (est.)[2]	38,843	5,348	7,238	26,257

[1]Data are based on the President's 1982 budget (March).
[2]Data are based on "Special Analysis K: Research and Development," *The Budget of the United States Government, Fiscal Year 1983*.
NOTE: Detail may not add to totals because of rounding.
SOURCE: National Science Foundation

applied research

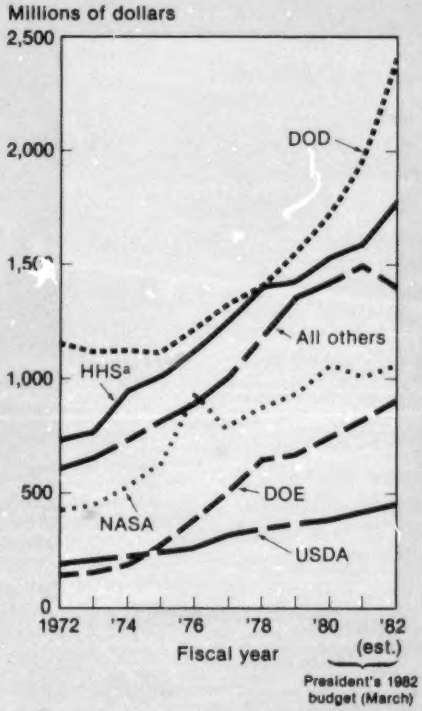
Virtually every Federal R&D support agency engages in applied research, with the total effort ranging over every field of science and including diversified projects addressed to differing agency responsibilities. More applied research is carried out in Federal laboratories than anywhere else. The industrial sector is second in performance, followed by universities and colleges.

Since applied research stems ultimately from basic research, support for applied research activities is not a policy concern in the sense these activities have the same potential as basic research for generating economic growth. Support for applied research, however, contributes to the general welfare, and the record shows that support for applied research has fluctuated in real terms in the past decade. The only steady real growth in recent years was between 1975 and 1978. With the recent budget cuts, a steady real decline is indicated between 1980 and 1982. In the 1975-80 period, an average annual increase of 3.1 percent in real support was recorded; between 1980 and 1982, the estimated real decline is 5.9 percent per year (based on data from the 1983 budget).

The leading agencies in applied research support are DOD, HHS, and NASA, followed by DOE and USDA (chart 3). DOD, HHS, and NASA account for approximately two-thirds of the Federal total. The elimination or stretch-out of NASA applied research programs and some current-dollar cutbacks in support to HHS applied research are the chief factors behind the 1980-82 funding decline. DOD support is expected to increase in this period.

In the latest estimates for 1982, applied research represents 19 percent of total Federal R&D obligations, compared with 22 percent in 1980.

Chart 3. Federal obligations for applied research by agency



[a]Data have been adjusted to reflect only health and human services programs (without education).
SOURCE: National Science Foundation

development

Development has always held the predominant share of Federal R&D totals, but during the seventies, this share diminished and the share of research increased. Now a reversal is underway. The share of development in the Federal R&D total in 1980 was 63 percent, but the most recent estimates for 1982 place it between 67 and 68 percent. As DOD R&D programs have grown and other agency programs, except for the NASA space shuttle, have been reduced or designated for less rapid growth, the development share has been given more weight because of the heavy emphasis on development in DOD program growth.

Three agencies in the 1970-82 period have accounted for 92 percent to 95 percent of all Federal development: DOD, NASA, and DOE. Changes in policy, however, will now bring about a decreasing role for DOE in Federal development support.

After falling almost steadily in constant dollars from 1967 to 1976, Federal development support began to grow and has shown a year-to-year increase in real terms. The average annual real increase between 1976 and 1980 was 3.3 percent; the estimated real increase between 1980 and 1982 is 5.1 percent (latest data).

Despite substantial increases in DOD support between 1980 and 1982, the Federal development total is still not as high in constant dollars as it was for any year in the 1964-68 period.

section 2.

federal r&d funding by budget function

function relationships

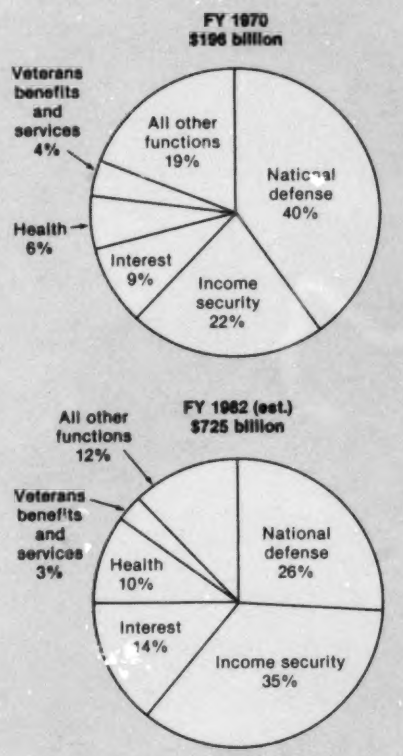
Considerable shifting has taken place in the relative emphasis placed on the different functional areas of the Federal budget.[8] For many years, as might be expected, outlays for national defense exceeded those for any other function, although the relative weight of national defense within the total did not remain constant. In 1974, for the first time, outlays for income security exceeded those for national defense, and a broad pattern emerged soon thereafter that remained quite stable until the 1982 budget, when different trends were clearly signaled.

In the 1974-81 period, income security outlays made up one-third, or slightly more, of total budget outlays, and national defense made up one-fourth, or slightly less. Interest on the Federal debt and outlays for health made up the next largest portions of total budget outlays, and both of these functions registered rapid growth.

In the 1982 budget, however, plans were laid for a powerful defense buildup at the same time that fiscal restraint was planned for most other areas, including many that consisted largely of entitlement programs, where spending is governed by established legislation rather than yearly appropriations. With the widespread spending reductions in nondefense areas, the share of the national defense function has begun to rise. National defense accounted for an estimated 26 percent of the total in the 1982 budget (chart 4), and the most recent budget projections point to the reemergence of defense as the leading budget growth area.[9] The portion of budget outlays allotted to defense is expected to grow to 36 percent of total outlays in 1986, by which time defense will again be the leading function, ahead of income security.

If history is a guide, there is no budget share for national defense that can be termed "proper." During the Korean War, the share of defense within the overall budget increased rapidly, reaching a high of 66 percent in 1953. It then fell steadily to a low of 40 percent in 1965 and, thereafter, under the pressure of the Viet Nam war, rose somewhat until 1968. After dropping in a relative sense from the late sixties until the second half of the seventies, defense outlays stabilized at approximately 24 percent of the budget from 1977 through 1981. They are now expected to rise again.

Chart 4. Share of major budget functions within overall Federal budget outlays



SOURCE: Office of Management and Budget

[8] The Federal budget is divided into 17 functional areas, including interest. Funding for these functions plus allowances and undistributed offsetting receipts make up the budget total, with no overlap between functions or agency programs within functions. The relative emphases given to the various areas of Federal responsibility can thus be immediately compared.

[9] Executive Office of the President, Office of Management and Budget, *Federal Government Finances, 1983 Budget Data*, February 1982 (unpublished).

r&d funding

Shifts in the pattern of R&D funding by budget function can be shown against this shifting pattern of change among functions in the overall budget.[10] In the R&D sphere, national defense has always been in a primary position, and in the decade of the seventies, the share of national defense within the R&D total has fluctuated in a far narrower range than has the defense share within the overall budget. Space, health, and energy are the next largest functions in term of R&D support (table 4). The R&D support rankings of these and other functions are in contrast to their positions in the overall budget. R&D programs within the income security function, for example, are a fraction of 1 percent of the R&D total, compared with the leading role of this function in the budget total.

trends by function

National defense (DOD programs and DOE atomic energy weapons programs) accounted for more than one-half of the Federal R&D total in the early seventies and somewhat less than one-half in the late seventies. In the 1980-82 period, a sharp rise in the position of national defense is the most outstanding feature of recent R&D funding trends. In 1980, R&D budget authority for national defense was 47 percent of total Federal R&D budget authority;[11] by the 1982 budget, the share for national defense was an estimated 57 percent.

Space research and technology, which is entirely made up of NASA programs, has always represented the second largest functional area. The share of space within the R&D total has fallen, however, from 20 percent in 1971 to 14 percent at the present time.

Throughout the seventies, funding for Federal R&D programs outside of the de-

[10] Over a 12-year period, NSF has classified Federal R&D programs on a functional basis to obtain a view of leading areas of R&D effort, the relative weights of these areas in the total R&D picture, and changes in growth rates for functions over selected periods of time. The system follows the function classification system used in the overall budget with only one adjustment. Of the 15 budget functions with R&D components, *general science, space, and technology* has been separated into two functions: *space research and technology* and *general science*. All the other functions in the R&D analysis are identical to the budget functions.

[11] R&D data by functions were compiled in terms of obligations for the 1971-77 period and in terms of budget authority for the 1978-82 period. Budget authority dollars are used by the Congress in making appropriation decisions, and for this reason, a shift was made to budget authority in NSF function analyses for recent years. The dollar amounts shown for R&D totals in text tables in this section may, therefore, differ slightly from those shown in section 1.

Table 4. Federal R&D funding by budget function:[1] fiscal years 1971-82

[Dollars in millions]

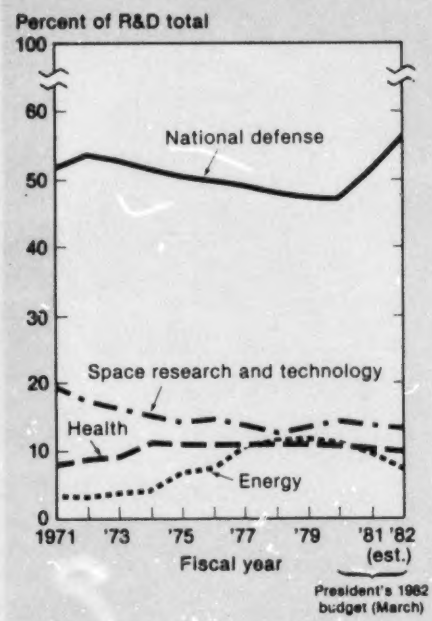
Function	Actual										Estimates	
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Total	$15,542.5	$16,495.9	$16,800.2	$17,410.1	$19,038.8	$20,779.7	$23,983.0	$26,518.9	$29,040.6	$31,622.7	$35,543.3	$40,794.8
National defense	8,109.9	8,901.6	9,001.9	9,015.8	9,679.3	10,429.7	11,863.8	12,899.4	13,791.0	14,946.4	18,442.0	23,261.4
Space research and technology	3,048.0	2,931.8	2,823.9	2,701.8	2,764.0	3,129.9	3,364.5	3,481.2	3,968.7	4,587.0	4,929.1	5,539.0
Health	1,287.8	1,546.7	1,585.0	2,068.6	2,170.2	2,350.6	2,628.5	2,967.7	3,401.3	3,694.3	3,824.5	4,042.7
Energy	555.8	574 0	629.7	759.2	1,363.4	1,648.5	2,561.8	3,134.4	3,461.4	3,603.2	3,515.2	3,016.2
General science	512.5	625.3	657.6	749.4	813.3	857.7	973.8	1,050.2	1,119.1	1,232.6	1,303.5	1,440.7
Natural resources and environment	415.5	478.5	553.8	516.0	624.3	683.0	753.1	903.9	1,009.6	999.3	1,038.2	976.1
Transportation	727.9	558.2	571.5	693.4	634.9	630.5	708.4	767.2	798.2	887.5	877.5	883.5
Agriculture	259.0	294.4	308.1	313.1	341.8	382.5	456.7	501.3	551.6	585.3	647.2	724.8
Education, training, employment, and social services	215.4	235.3	290.4	236.4	238.6	254.8	230.1	345.1	353.5	468.0	338.8	299.2
Veterans benefits and services	62.9	69.1	74.3	84.8	94.8	97.7	107.0	111.1	122.8	125.8	138.2	145.7
International affairs	31.9	28.6	28.3	23.8	29.0	42.4	66.3	57.2	116.8	127.3	126.9	142.4
Commerce and housing credit	89.5	49.7	50.2	50.8	64.9	68.7	70.5	76.7	92.7	102.1	110.7	122.2
Community and regional development	64.6	65.8	78.4	82.1	92.5	108.5	100.9	91.9	127.3	119.4	121.4	91.5
Income security	144.9	106.3	106.3	70.9	71.9	48.3	55.2	67.3	56.8	77.2	76.1	55.2
Administration of justice	10.4	23.4	33.2	34.7	44.3	34.8	29.9	43.7	46.5	45.1	27.7	30.7
General government	6.6	7.6	7.4	9.3	11.7	11.9	12.6	20.3	23.3	22.0	26.2	23.5

[1] Listed in descending order of 1982 budget authority. Data for 1971-77 are shown in obligations; data for 1978-82 are shown in budget authority. Data for 1981 and 1982 are estimates taken from the 1982 Federal budget published in March 1981.

NOTE: Detail may not add to totals because of rounding.

SOURCE: National Science Foundation

Chart 5. Trends in distribution of Federal R&D funding by leading function



SOURCE: National Science Foundation

fense and space functions grew more rapidly than funding for the defense-space program group. By 1979, these other programs accounted for 39 percent of the Federal R&D total, compared with 28 percent in 1971 (chart 5). Programs in these areas are largely connected with Federal responsibilities for promoting the general welfare, and services are directed chiefly at groups in the private sector. This is in contrast to defense and space programs, where the primary user of services is the U.S. Government.

The first half of the seventies was characterized by very low rates of growth for defense, absolute declines in funding for space, and comparatively rapid rates of growth in R&D funding support for the next four functional areas—health, energy, general science, and natural resources and environment (table 5). Between 1971 and 1975, the average annual rate of increase of 25.1 percent for energy R&D funding was unprecedented for a major function.[12]

[12] Major functions are defined as those with R&D funding levels of more than $500 million in the 1982 budget (March).

Health and general science programs also received strong endorsement, with comparable growth rates of 13.9 percent and 12.2 percent, respectively. Despite sizable funding increases for the four leading "civilian" areas, the weight of national defense and space within the total was such that the overall rate of increase in Federal R&D funding was only 5.2 percent.

By the 1975-80 period, R&D funding for both defense and space had accelerated, with an average annual increase of 9.1 percent for defense and 10.7 percent for space. Largely because of these changes, the rate of growth for overall R&D funding increased to 10.6 percent, a rate twice that of the first part of the decade. R&D growth for each of the four next largest functional areas was somewhat less in each case than in the 1971-75 period, but was still relatively rapid. Energy R&D funding, with an average annual increase of 21.5 percent, continued to outpace all other functions. During this period, the increase in R&D support to agriculture programs was noteworthy—averaging 11.4 percent per year, compared with 7.2 percent in the earlier period.

A sharp shift in emphasis became evident by 1981. The overall R&D increase from 1980 to 1981 was an estimated 13 percent, most of which was derived from a 23-percent rise in R&D budget authority for national defense—by now the only area, except for agriculture, where a real increase occurred. In energy, a turnabout in policy had produced an actual decline in R&D funding for the first time on record.

the 1982 budget

In the March budget for 1982, the emphasis on defense continued, with an increase of 26 percent in R&D budget authority. Funding for defense made up the bulk of the Federal R&D total (chart 6). Setting aside a 12-percent increase for space, mostly allotted to the space shuttle, defense funding accounted for the 15-percent increase in overall Federal R&D budget authority planned at that time. Absolute decreases were shown for energy and natural resources and environment, and no real growth was shown for health. In general science and agriculture, however, growth was somewhat ahead of anticipated inflation. As a result of new support policies, the shares of most functions within the Federal 1982 R&D total decreased relative to national defense (table 6).

In the revisions made by the Reagan administration in the Carter budget for 1982, energy and space received the greatest

Table 5. Federal R&D funding by major budget function:[1] Average annual percent change in selected periods

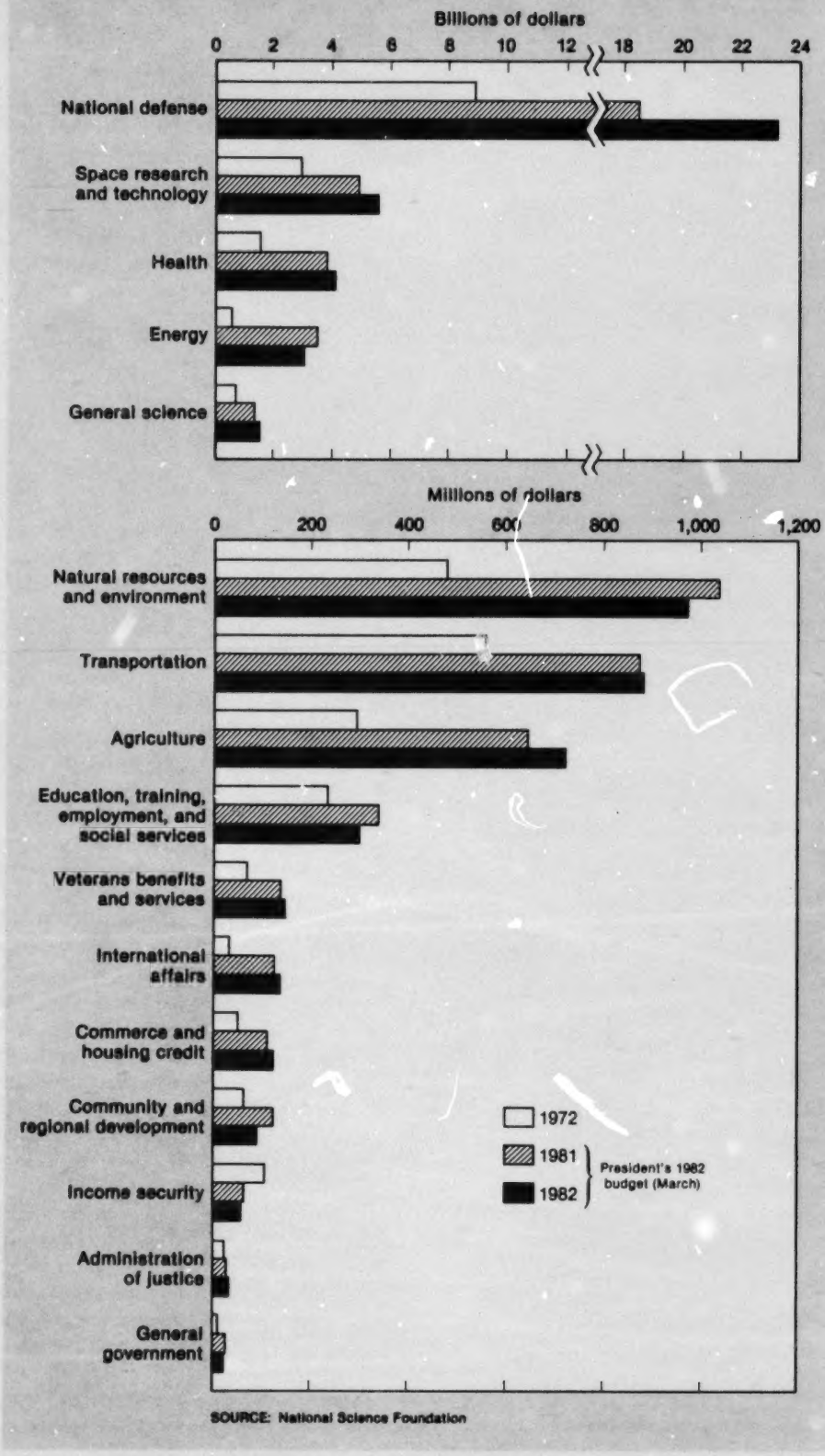
Function	Actual		Estimated		
			March 1981[2]		February 1982[3]
	1971-75	1975-80	1980-81	1981-82	1981-82
Total	5.2%	10.6%	12.5%	14.8%	8.9%
National defense	4.5	9.1	23.4	26.1	19.6
Space research and technology	-2.4	10.7	7.5	12.4	9.5
Health	13.9	11.2	3.5	5.7	-.2
Energy	25.1	21.5	-2.4	-14.2	-17.5
General science	12.2	8.7	5.8	10.5	3.5
Natural resources and environment	10.7	9.9	3.9	-6.0	-10.3
Transportation	-3.4	6.9	-1.1	.7	-14.0
Agriculture	7.2	11.4	10.6	12.0	5.3
All others	.8	10.2	-10.1	-4.4	-17.5

[1] Listed in descending order of R&D budget authority in the 1982 budget.
[2] Data are taken from *Federal Funds for Research and Development, Fiscal Years 1980, 1981, and 1982*, Volume XXX (Detailed Statistical Tables) (NSF 81-325).
[3] Data are taken from Office of Management and Budget, "Special Analysis K: Research and Development," The Budget of the United States Government, Fiscal Year 1983.

NOTE: Calculations are based on obligation data for the 1971-77 period and on budget authority data for all subsequent years.

SOURCE: National Science Foundation

Chart 6. Federal R&D funding by budget function: FY 1972, 1981 (est.), and 1982 (est.)



SOURCE: National Science Foundation

Table 6. Percent distribution of Federal R&D funding by budget function:[1] fiscal years 1971-82

Function	Actual									Estimates		
	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982
Total	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
National defense	52.2	54.0	53.6	51.8	50.8	50.2	49.5	48.6	47.5	47.3	51.9	57.0
Space research and technology	19.6	17.8	16.8	15.5	14.5	15.1	14.0	13.1	13.7	14.5	13.9	13.6
Health	8.3	9.4	9.4	11.9	11.4	11.3	11.0	11.2	11.7	11.7	10.8	9.9
Energy	3.6	3.5	3.7	4.4	7.2	7.9	10.7	11.8	11.9	11.4	9.9	7.4
General science	3.3	3.8	3.9	4.3	4.3	4.1	4.1	4.0	3.9	3.9	3.7	3.5
Natural resources and environment	2.7	2.9	3.3	3.0	3.3	3.3	3.1	3.4	3.5	3.2	2.9	2.4
Transportation	4.7	3.4	3.4	4.0	3.3	3.0	3.0	2.9	2.7	2.8	2.5	2.2
Agriculture	1.7	1.8	1.8	1.8	1.8	1.8	1.9	1.9	1.9	1.9	1.8	1.8
Education, training, employment, and social services	1.4	1.4	1.7	1.4	1.3	1.2	1.0	1.3	1.2	1.5	1.0	.7
Veterans benefits and services	.4	.4	.4	.5	.5	.5	.4	.4	.4	.4	.4	.4
International affairs	.2	.2	.2	.1	.2	.2	.3	.2	.4	.4	.3	.3
Commerce and housing credit	.6	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3	.3
Community and regional development	.4	.4	.5	.5	.5	.5	.4	.3	.4	.4	.3	.2
Income security	.9	.6	.6	.4	.4	.2	.2	.3	.2	.2	.2	.1
Administration of justice	.1	.1	.2	.2	.2	.2	.1	.2	.2	.1	.1	.1
General government	(2)	(2)	(2)	.1	.1	.1	.1	.1	.1	.1	.1	.1

[1] Listed in descending order of 1982 budget authority. Data for 1981 and 1982 are based on estimates taken from the 1982 Federal budget published in March 1981.
[2] Less than .05 percent.

NOTE: Detail may not add to totals because of rounding.
SOURCE: National Science Foundation

dollar reductions. Large cuts were made in support for DOE solar energy, fossil energy (especially coal liquefaction), and energy conservation R&D programs, but support for DOE nuclear fission programs increased, mostly reflecting the reinstatement of the liquid metal fast breeder reactor demonstration project. Cuts were made within the broad NASA space transportation systems program (although the space shuttle continued to be given high priority), and major reductions were made in space science programs.

Elimination of an R&D program in welfare reform conducted by the Department of Labor resulted in a large reduction within the education, training, employment, and social services function.

Cuts were also made in funding for general science programs, notably in NSF social sciences research support, and in the NSF industrial science and technological innovation program. A group of special NSF academic sector programs was eliminated.

A number of funding cuts were made in the natural resources and environment function on programs conducted by the National Oceanic and Atmospheric Administration within the Department of Commerce, on the water research and technology program within the Department of the Interior, and on pollution control and abatement research conducted by the Environmental Protection Agency (EPA).

subsequent budget changes

At the time of the 1982 budget revisions in September-October 1981, the disparity between budget proposals for national defense R&D programs and those for programs of all the other functions became even greater. Although the relative increase for defense was reduced to 21 percent over 1981, the defense R&D program group was still scheduled for considerable real growth. Every other R&D area now reflected a reduction from the 1981 level, with the largest relative decrease shown in energy, followed by natural resources and environment. Space was the only function besides defense with a current-dollar increase, but even this area showed a real decline. If the space shuttle had not been exempt from reductions, the space R&D total would probably not have grown at all.

The budget expectations of September-October, however, have now been modified, and R&D decreases for some functional areas in 1982 will not be as severe as were then indicated. An increase of 9 percent in total R&D budget authority allows for some real growth. The defense increase is now estimated at 20 percent over 1981, and the increase for space at 9 percent. Health R&D budget authority is expected to remain level, and general science is scheduled for a small relative increase, less than the anticipated rate of inflation. By far the largest relative decrease in R&D budget authority is in energy (18 percent). This decrease is in line with an administration policy of withdrawing from energy programs that appear to have near-term payoffs and that would best be left to private commercial development. Substantial relative decreases are also indicated for the transportation and natural resources and environment functions.

section 3.

the dod share in federal r&d funding

At every stage of the 1982 budget evolution, the role of defense was paramount. A major policy of the administration has been to rebuild defense capabilities while imposing fiscal restraint on most other Federal programs. The emphasis that had been placed on defense spending in the original 1982 budget was considerably intensified in the revised 1982 budget as presented in March 1981 by the incoming administration. In this budget, overall budget authority for national defense showed a 25-percent increase over 1981—higher than the increase for most other functional areas of the budget, many of which showed actual reductions from 1981 or lower rates of increase than in recent years.

r&d patterns, 1980-82

Since decisions to increase military spending are usually tied to restructuring of major weapons systems, funding for the R&D component of defense budgets will tend to rise when overall budgets for defense are expanding. Some lags in rates of R&D growth may occur, however. This is because five or more years may be required for development of a new weapons system from initial definition to completion of testing and introduction into the operating forces.

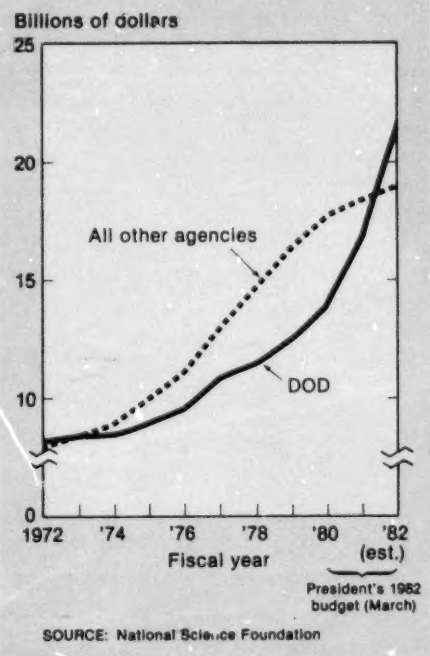
DOD programs make up more than nine-tenths of R&D funding for the national defense function. DOE atomic energy weapons programs account for the remainder. These programs showed increased support in 1981 and 1982, after two years of virtually no current-dollar growth. But since DOD was by far the largest R&D growth area in the 1981 and 1982 budgets, this analysis will focus on DOD programs.

After almost two decades of no real growth, R&D obligations for DOD in the 1981 and 1982 revised budgets showed 1-year increases of 20 percent and 28 percent, respectively—well ahead of anticipated inflation. Even though the $21.5 billion in 1982 obligations requested for these DOD programs in March 1981 was scaled down to $20.5 billion in the second budget revision in October, this new 1982 figure was still 22 percent greater than the R&D total for 1981 and far ahead of R&D growth for any other Federal agency.

By the September-October budget, decreases were, in fact, indicated for most of the agencies, and the R&D total for DOD was greater than the total for all other agencies combined. This had also been the case in the earlier version of the budget in March (chart 7), but the dollar gap between DOD R&D programs and the combined total for all other agency R&D programs was now greater.

A new pattern had begun to emerge. By September, the non-DOD component of the new administration's budget showed a 7-percent *decrease* in R&D obligations from 1981, compared with an increase of 3 percent in the previous March budget. While policies of four successive administrations over a 10-year period were pointed toward increased R&D support for defense within the total budget, the first three administrations had endorsed R&D increases in most civilian areas in most years. Later data, based on the 1983 budget, show that the new pattern is holding. They reveal an increase of 25 percent for DOD R&D obligations in 1982 and a decrease of 1 percent from 1981 for all the other agencies combined.

Chart 7. Federal R&D obligations by DOD and by all other agencies combined



SOURCE: National Science Foundation

rapid shifts in emphasis

By the time of the 1980 budget, the rates of increase in Federal R&D funding had begun to lag. That budget reflected a plan to slow the economy to counter the continuing rise in inflation, as contrasted with earlier budgets that were designed for economic stimulation to reduce unemployment. The commitment to a sharp reduction in the rate of growth of Federal spending had an impact on R&D obligation levels; the 1980 R&D total was scheduled for an increase of only 4 percent over 1979.[13] Some agencies showed slight decreases; for most of the rest, even including DOD, the increases were less than the rate of inflation.

The 1981 budget continued the strategy of restraint. Real increases were limited to high priority areas, and defense was designated as one of the highest. In the revised 1981 budget, DOD R&D obligations showed a relative increase of 20 percent over 1980, while the R&D increase for all other R&D programs taken together was only 4 percent. The total Federal R&D increase, projected at 11 percent (1 percent in real terms), was attributable almost entirely to funding proposals for DOD.

The 1982 budget of the new administration carried the process even further as it went through successive revisions. Non-DOD programs eventually showed a slight aggregate decline from 1981. The emphasis on defense and deemphasis on other programs can be gauged by the rise in the defense share of the Federal R&D total, which after falling to 47 percent in 1980, had risen to an estimated 59 percent in the September-October proposed revisions. Although subsequent developments reduced the 1982 share of all defense programs to 57 percent in 1982, defense programs can still be expected to preempt the use of science resources and to have far-reaching impacts on R&D-performing institutions, demand for scientific and engineering skills, and growth of various fields of science.

the seventies

Federal R&D funding moves in cycles of growth and retardation. Broad shifts in emphasis occur as different issues engage public interest in different periods and dominate policymaking and legislative processes. Thus, even though defense R&D funding—and R&D funding of DOD as an agency—has always made the largest contribution to Federal R&D support, the influence of that support on total Federal R&D growth has varied from one period to another.

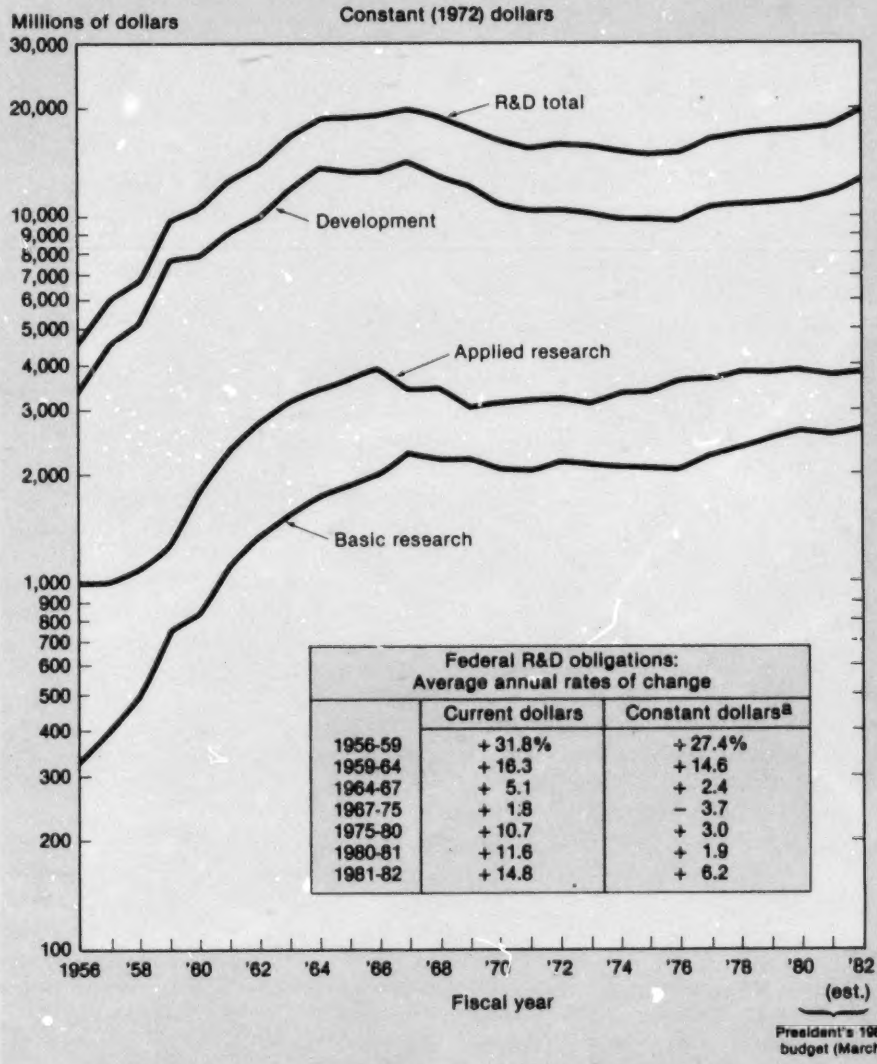
Two broad phases of the overall Federal R&D funding cycle are distinguishable in the seventies, but these did not necessarily parallel the curves of DOD R&D funding, especially in the period 1975 to 1980.

The first phase, in the early seventies, should be viewed as part of a longer R&D support trend extending from 1967 to 1975. During that period, a long-term real decline in Federal R&D obligation levels occurred, and the influence of DOD was pronounced. Even though certain areas reflected real R&D increases—notably health, general science, and agriculture—growth in these areas did not override the lags in military and space support.

Between 1967 and 1975, DOD R&D obligations fell at an average annual real rate of 4.0 percent, and overall Federal R&D funding registered an average annual real decline of 3.7 percent (chart 8).

Chart 8. Trends in Federal R&D obligations

(Semilog scale)



Federal R&D obligations: Average annual rates of change

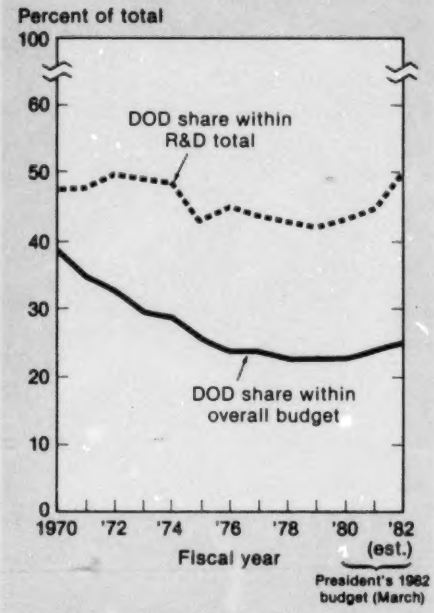
	Current dollars	Constant dollars[a]
1956-59	+31.8%	+27.4%
1959-64	+16.3	+14.6
1964-67	+ 5.1	+ 2.4
1967-75	+ 1.8	- 3.7
1975-80	+10.7	+ 3.0
1980-81	+11.6	+ 1.9
1981-82	+14.8	+ 6.2

[a]Based on the fiscal year GNP implicit price deflator with an OMB estimate of 8.2 percent for inflation in fiscal year 1982.

SOURCE: National Science Foundation

[13]By the following year, supplemental requests, congressional appropriation actions, and carryovers had changed the 1980 increase to 10 percent over 1979.

Chart 9. Share of total outlays for DOD within the overall Federal budget compared with the share of DOD R&D and R&D plant outlays within Federal R&D and R&D plant outlays



SOURCES: National Science Foundation and Office of Management and Budget

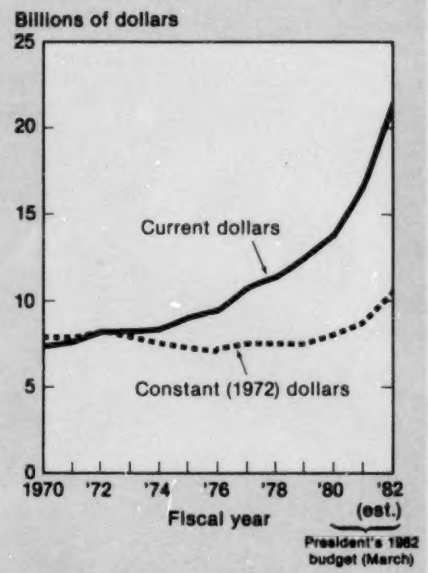
The DOD R&D and R&D plant share ranged from 43 percent to 50 percent of the Federal R&D and R&D plant total, and DOD support strongly influenced funding directions (chart 9). But other forces were also at work. The chief of these was the downward trend in current-dollar obligations for NASA programs and the absence of any real growth in Atomic Energy Commission (AEC) R&D programs. The overall decline would have been greater except for increases in biomedical research sponsored by the Department of Health, Education, and Welfare (HEW) and some growth in NSF research support.

In the second phase, 1975-80, the growth rates of overall R&D funding and DOD R&D funding were not as close as they had been in the past. An average annual real growth of 3.0 percent in total Federal R&D obligations contrasted with comparable real growth for DOD of only 1.6 percent (chart 10). During this interval, R&D obligations for the next three R&D support agencies—NASA, DOE (until 1976 the Energy Research and Development Administration), and HHS—grew at rates far faster than those of DOD (on a constant-dollar basis). The DOD share of the Federal R&D and R&D plant total was lower than ever before, ranging from 42 percent to 46 percent.

During the seventies, Federal R&D and R&D plant outlays fell as a share of GNP almost every year until 1979, then rose in 1980 to 1.24 percent, and rose further to an estimated 1.29 percent in the March budget for 1982 (chart 11).[14] The Federal share *without* DOD, however, did not fall between 1974 and 1978 and showed a significant decline only in the 1982 budget. The DOD share, by contrast, fell until 1979 and then rose steadily. As chart 11 suggests, the effects of Federal R&D support on the economy in the eighties will stem mostly from military requirements.

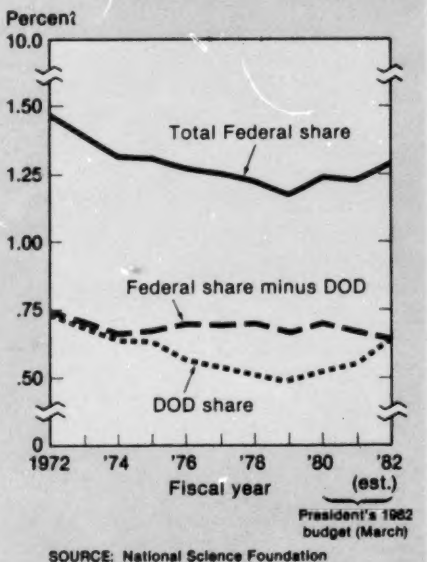
[14] One-tenth of 1 percent of GNP at current levels is approximately $3 billion.

Chart 10. Trends in DOD obligations for research and development



SOURCE: National Science Foundation

Chart 11. Federal R&D and R&D plant outlays as a share of GNP



SOURCE: National Science Foundation

major r&d programs

At the start of the seventies, DOD R&D funding had been declining for three years, but a small current-dollar growth trend began in 1971. Major programs that had reached advanced stages of development included a number of versions of the Air Force F-111A, the C-5A transport aircraft, light attack aircraft, and early warning aircraft; the Navy EA-6B electronic warfare aircraft; and the Army's helicopter development effort. Development was accelerating, however, on the strategic Minuteman III and Poseidon intercontinental ballistic missiles. By 1971, major development was beginning on the Air Force B-1 strategic bomber, and the tactical Navy F-14 (in various versions) and the Air Force F-15 fighter aircraft were in full-scale development.

By 1972, aircraft entering full-scale development included the B-1 bomber, the F-5 international fighter, and the S-3A antisubmarine aircraft. Missile systems in full-scale development included the Army SAM-D air defense and the Navy Aegis fleet defense system. Major increases were provided for the Navy undersea long-range missile (ULMS) and Harpoon

antiship missile programs, as well as for the Air Force airborne warning and control system (AWACS). These increases and the smaller increases for a number of Navy ship programs more than offset decreases for programs nearing completion. The confluence of so many programs reaching a high development phase produced a large relative R&D increase for DOD in 1972 over 1971 that would not be matched again for five years.

The 1973 budget foreshadowed later events in the administration's request for an $8 billion increase in total obligational authority for defense (including funds no longer needed for Viet Nam war costs). The administration placed emphasis on the strategic forces triad of bombers, land-based missiles, and sea-launched missiles. Each leg of the triad was expected to have an independent capability of absorbing an all-out Soviet attack while being able to inflict unacceptable damage in retaliation. Budget plans included modernization of the Minuteman missile force, a moderate increase in funding for the B-1 bomber, and improvement in the command and control system.

Administration proposals for increases in budget authority for defense continued through the midseventies. In 1974, the size of the proposed increase implied real increases in defense appropriations of approximately 4 percent a year for the rest of the decade. Although Congress did not approve every request, it fundamentally endorsed the policy of strong defense growth, largely because defense expenditures by the Soviet Union had been increasing substantially in real terms and because the ability of the United States to meet international commitments was seen to rest on a strong defense buildup.[15]

Until 1976, however, even though a multitude of weapons programs were moving through various stages of development and work continued within the technology base area, the DOD R&D total increased only slightly from year to year and actually declined in real terms. Between 1970 and 1976, development was completed on the Minuteman and Poseidon strategic missile systems, the Air Force 5E international fighter and F-15 fighter aircraft; the Navy Condor and Phoenix missile systems, the MK-48 torpedo, S-3A ASW aircraft, F-14 fighter versions, and E-2C airborne early warning aircraft; and the Army Safeguard strategic antiballistic missile system. By 1976 the funding profile for the Navy's Trident submarine began to decline after reaching full-scale development. At the same time, development on the Trident submarine-launched missile system entered a growth curve.

new weapons

In the seventies, beginnings were made on programs that later were to be of major importance. The 1973 budget mentioned for the first time prototype development of a main battle tank, which later became the Army XM-1. During that year, technology efforts were also directed toward future antiballistic missile systems, leading to the M-X strategic missile. Funding for investigations of the military uses of the NASA space shuttle was first mentioned in the 1974 budget. The submarine-launched strategic cruise missile entered development as did a prototype satellite to demonstrate precise navigation capabilities, which later became the NAVSTAR global positioning system.

The increases made in overall defense appropriations led to R&D increases for DOD of 7 percent and 14 percent in 1976 and 1977, respectively. In real terms, funding showed no growth the first year, but rose 6 percent the second year—the first real increase since 1972.

High emphasis was placed in these budgets, on air-, surface-, and submarine-launched strategic cruise missiles and on the Air Force advanced ballistic missile technology program. B-1 bomber development also received major increases, as did the Air Force F-16 and Navy F-18 tactical fighter aircraft. Programs entering major development were the Navy Aegis fleet defense missile system and the Army Pershing II missile, the last as part of weapons standardization with NATO countries.

The 1978 budget stated that "major development efforts in 1978 will lead to modernization of all three components of the retaliatory triad of strategic systems."[16] Work went forward on the Trident sea-launched missile system, the B-1 bomber, and the M-X land-based intercontinental ballistic missile. To provide future strategic options, two cruise missiles continued in full-scale development: the Navy Tomahawk SLCM and the Air Force ALCM. In the tactical area, the Navy LAMPS ASW helicopter was added to the programs under major development. The Army meanwhile explored concepts for strategic defense.

By the 1979 budget, an earlier decision to terminate procurement of the B-1 bomber led to a phasing down of funding for development work on this project, but major development was to continue on other large strategic systems in missiles and missile defense as well as on a host of tactical weapons. The DOD budget statement also included the announcement of a policy to provide for real growth in the technology base mission area (basic and applied research) to maintain the technological lead of the United States relative to nations that might pose a threat.[17]

Despite far-ranging program activities, total DOD R&D growth in the seventies was still insufficient to stay ahead of inflation in most years. In 1980, even though the DOD R&D total showed real growth over the previous year, it was still below the 1970 total in constant dollars. By this time, the M-X strategic missile had become the largest single DOD development program, with the Army F/A18 Hornet aircraft and the NAVSTAR global positioning system next in size. Funds were requested in 1980 for a new, longer-range, sea-based missile—the Trident II. Special emphasis was placed in the tactical area on improving U.S. defenses against conventional and theater nuclear attacks by Warsaw Pact nations. Also stressed was a proposal for real growth of 10 percent in research and 5 percent in exploratory development to expand the U.S. technological lead.

Only in 1981 and 1982 did the increases in DOD R&D obligations reach levels that

[15] See Blechman, Barry M., Edward M. Gramlich, and Robert W. Hartman, *Setting National Priorities: The 1976 Budget* (Washington, D.C.: The Brookings Institute, 1975), pp. 85-6.

[16] Executive Office of the President, Office of Management and Budget, *Budget of the United States Government, Fiscal Year 1978, Appendix* (Washington, D.C., 1977), p. 253.

[17] Technology base is made up of basic research and applied research. Basic research is supported by RDT&E 6.1 research funds, which are directed to "scientific study and experimentation (to increase) knowledge and understanding in those fields . . . of science related to long-term national security needs." Applied research is supported by 6.2, or exploratory development, funds and includes all efforts directed toward solution of specific military problems, short of major development projects.

produced significant growth in real terms. Plans for 1982 called for continued modernization of strategic forces and development of a number of key tactical programs to support NATO commitments and to respond to a variety of contingencies. The M-X missile had assumed the dominant position in the inventory of DOD development programs; funding was anticipated at $2.4 billion in the March version of the budget, but was later reduced to $1.9 billion in the fall revision. Next in size was the B-1B bomber development program, reintroduced at $335 million and later raised by the administration to $471 million.[18] Other leading development programs included the C-X airlift, the NAVSTAR, the Trident II missile system, the Navy AV-8B aircraft, the Army ballistic missile defense systems technology program, and work on the military aspects of the space shuttle. As in the three previous budgets, significant real growth was proposed for technology base.

the background

The increasing emphasis on DOD programs at the present time is to some extent analagous to the period of the late fifties and early sixties. In the 1956-59 period, the DOD share of total Federal R&D and R&D plant obligations was 74 percent. This period has been selected as the starting point of this analysis because the *Federal Funds* survey began in 1956 to elicit data for all character-of-work components—basic research, applied research, and development (chart 8). The extremely rapid rise in total Federal R&D obligations between 1956 and 1959 (27.4 percent on an annual average in constant dollars) was largely attributable to growth in DOD support (28.1 percent in constant dollars). New types of weapons were emerging, and after a period of budget restraint in the midfifties, the climate was conducive to increased military R&D funding in areas such as guided missiles and the application of nuclear energy to ship and aircraft propulsion.

Actual funding growth usually does not become apparent until several years after original plans and proposals are made. Congress may take a year or more to respond to authorization requests. Furthermore, obligations, once authorized, may be spread over several years. A weapons program can start small in dollar terms and become a major factor in R&D budget planning in later years. Some programs stay in various stages of development for many years as improvements are added to reflect the state of the art. Upsurges in total military R&D funding can be created when major programs reach the stage of full-scale development, especially when two or more such programs reach this stage at the same time.

Two such funding peaks occurred in 1963 and 1967. Thereafter, total DOD R&D obligations fell in constant dollars until 1972, when a smaller peak occurred once again, producing significant real growth for that year. During the late sixties, a number of major DOD programs were reaching the end of the development phase and had entered into procurement.

The sixties were characterized by greater diversity in the overall Federal R&D program mix and also by decelerating rates of growth in both total Federal and DOD R&D support. The influence of DOD on overall R&D funding trends underwent a decline. Funding curves for DOD and for the Federal total continued upward until 1964, and then almost flattened out in the next three years. From 1959 to 1964, the average annual rate of growth for total Federal R&D obligations was 14.6 percent in constant dollars against a comparable growth rate of 5.5 percent for DOD R&D support.

In these years, funding for the new NASA space venture was rising precipitously, which placed this agency second in R&D support as early as 1963, a position it has retained ever since. Support for biomedical research also increased significantly within the National Institutes of Health (HEW) and for work on nuclear energy within AEC, much of it for civilian reactor development. Between 1959 and 1964, the DOD share of total Federal R&D and R&D plant obligations fell from 74 percent to 48 percent as these and other civilian programs gained in emphasis.

The end of a cycle became evident between 1964 and 1967. Real growth in total Federal R&D funding slowed to 2.4 percent on an annual average, and the comparable real growth rate for DOD was 0.6 percent. By 1967, a high point in both the Federal R&D total and the DOD R&D total was reached in constant dollars. The Federal R&D total has not been matched since that time, but the proposed DOD R&D total in the 1982 budget exceeded the earlier high.

dod impacts

Planned increases in DOD R&D funding will increase the DOD impact on all major performers and on certain fields of science. This is evident in data submitted to the *Federal Funds*, Volume XXX survey, based on the 1982 budget as of March 1981. Although subsequent revisions to that budget reduced the funding levels of almost all agencies, including DOD, the increases shown in the survey in the DOD share of various R&D categories between 1980 and 1982 can provide, on the whole, a reliable indication of funding distribution trends. The chief distortion is found in the amount of DOD development and applied research support to industry in 1982, which was somewhat overstated in the survey.

performers

DOD accounts for the largest share of Federal R&D support in three R&D-performing areas: Federal intramural, industrial firms, and federally funded research and development centers (FFRDC's) administered by nonprofit institutions. By comparison, the DOD share of total Federal R&D obligations to the academic sector is not large and has not been so for many years.

As shown in table 7, the DOD share of Federal R&D funds directed to industry would increase from 63 percent in 1980 to an estimated 70 percent in 1982, and the DOD share of the Federal intramural total would increase from 48 percent to 56 percent. Even in the academic sector, an increase in share is indicated—from 12 percent to 15 percent.

basic research

Basic research funding has always been a central concern of the science community; in recent years, the relationship of basic research to economic growth and productivity has also engaged the attention of economists and other analysts. In constant dollars, basic research funding grew rapidly

[18] See House of Representatives, 97th Congress, 1st Session, *Conference Report No. 97-410*, December 15, 1981, p. 48.

Table 7. Comparison of total Federal and DOD R&D obligations by performer: fiscal years 1980 and 1982 (estimate)

[Dollars in millions]

Performer	1980			1982 estimate		
	Federal total	DOD	DOD share of Federal total	Federal total	DOD	DOD share of Federal total
Total	$31,680.4	$13,981.0	44.1%	$40,602.0	$21,523.2	53.0%
Federal intramural	7,929.4	3,796.5	47.9	9,995.8	5,585.9	55.9
Industrial firms excluding FFRDC's[1]	14,422.0	9,022.4	62.6	20,350.9	14,333.1	70.4
FFRDC's[1] administered by industrial firms	1,408.1	91.6	6.5	1,536.3	139.6	9.1
Universities and colleges excluding FFRDC's[1]	4,276.9	495.3	11.6	4,777.7	709.7	14.9
FFRDC's[1] administered by universities	1,591.6	149.1	9.4	1,882.7	192.6	10.2
Nonprofit institutions excluding FFRDC's[1]	1,133.9	114.4	10.1	1,093.0	148.5	13.6
FFRDC's[1] administered by nonprofit	441.8	254.9	57.7	445.2	366.0	82.2
All other performers	476.7	56.8	11.9	520.5	47.9	9.2

[1]Federally funded research and development centers.

NOTE: These data are taken from agency reports to the National Science Foundation based on the 1982 budget as presented in March 1981. Subsequent revisions to the budget reduced R&D funding levels for almost all agencies. The data for 1982 in most categories are, therefore, somewhat overstated. The increases in the DOD share of the various performer categories are probably not overstated, however.

SOURCE: National Science Foundation

from 1956 to 1967 and, after a small decline, remained on a virtual plateau until 1976. This long stagnation caused concern on policymaking levels, and deliberate steps were taken, with some success, by two successive administrations to reverse the trend.

In the late fifties, DOD was the leading agency in support to basic research; by 1964, however, DOD had dropped behind HEW and NASA in sponsorship and, by 1966, had fallen behind AEC as well. Until the late sixties, the strong push on the part of those and other civilian agencies maintained overall growth in support for basic research.

In the seventies, NSF became firmly established as the second agency after HEW in support for basic research. Until 1978, the influence of DOD was diminished and was usually less than that of the four other agencies leading in support for basic research. Growth in DOD funding then increased significantly as part of the policy of renewed support to technology base programs, and as rates of funding growth slackened in other agencies in the 1981 and 1982 budgets, DOD became the third agency in Federal support for basic research.

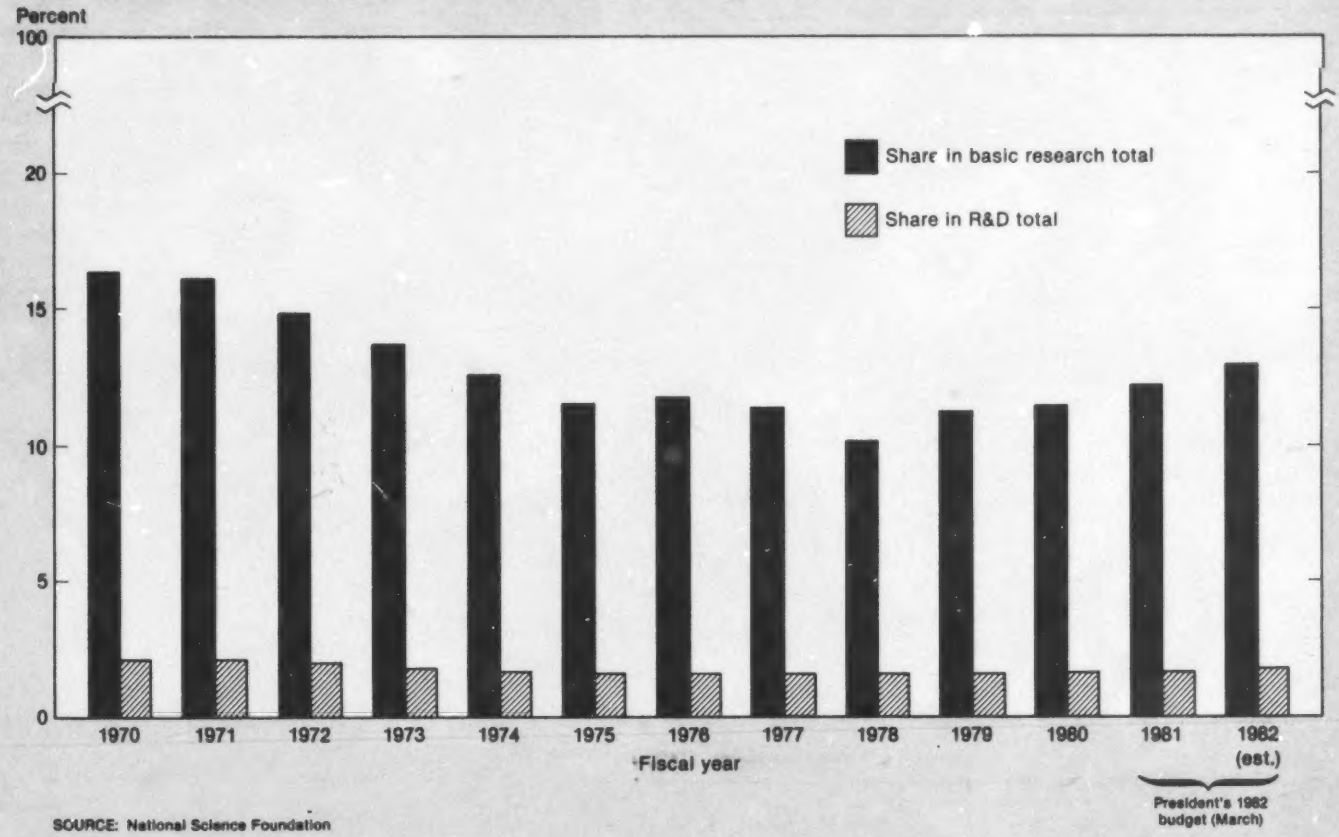
Even so, the influence of DOD on trends in total basic research funding has not been great in the past 12 years. The DOD share within the Federal total fell from 16 percent in 1970 to 10 percent in 1978 (chart 12). At this time, total Federal support for basic research had begun to rise, reaching a new constant-dollar high in 1980. Real support declined in 1981, but was expected to increase slightly in the March version of the 1982 budget. Despite the fact that the 1982 budget provided for an 18-percent increase over 1981 in DOD basic research obligations to more than $700 million, the anticipated amount was still only 13 percent of the Federal basic research total.

Universities and colleges will probably gain from the increased DOD support for basic research. Estimates in the 1982 budget showed DOD planning to place 44 percent of the agency's basic research obligations with the academic sector, compared with 39 percent in 1980, as part of a recently announced policy to establish closer university ties. DOD is the third agency after HHS and NSF in support for basic research to universities and colleges, accounting for approximately one-tenth of the Federal support to this sector.

Certain fields are particularly influenced by DOD support, and this influence can be expected to grow. Based on reports from the six leading support agencies for basic research in the university and college sector, DOD represents almost 12 percent of total support in 1982, up from 9 percent in 1980 (table 8). The chief DOD impact is on mathematics and computer sciences, where the DOD share is expected to grow from 35 percent in 1980 to 41 percent in 1982. The impact on engineering is only slightly less—the DOD shares are expected to grow from 34 percent in 1980 to an estimated 38 percent in 1982. In aeronautical and electrical engineering (including electronics), DOD accounts for one-half or more of all the Federal basic research support to universities. DOD also provides leading support to basic engineering research in metallurgy and materials.

The impacts of DOD support are also evident in the environmental sciences and psychology. The DOD share of Federal support to universities and colleges for psychology, is expected to grow from 18 percent in 1981 to 25 percent in 1982. The DOD share of support to the environmental sciences in 1982 is expected to reach 20 percent, only slightly above the 1981 share.

Chart 12. Share of DOD basic research within the Federal basic research and Federal R&D totals



SOURCE: National Science Foundation

Table 8. Comparison of total Federal and DOD basic research obligations to universities and colleges by major field of science: fiscal years 1980 and 1982 estimate

[Dollars in millions]

Field of science	1980			1982 estimate		
	Federal total	DOD	DOD share of Federal total	Federal total	DOD	DOD share of Federal total
Total	[1]$2,291.3	$208.3	9.1%	[1]$2,740.0	$314.4	11.5%
Life sciences	1,219.5	15.5	1.3	1,429.0	22.1	1.5
Physical sciences	375.9	37.9	10.1	482.9	60.3	12.5
Environmental sciences	255.3	46.1	18.0	296.1	58.7	19.8
Engineering	208.4	70.6	33.9	289.1	110.2	38.1
Mathematics and computer sciences	79.8	28.3	35.4	116.3	47.9	41.2
Psychology	52.4	9.3	17.7	55.3	13.8	24.9
Social sciences	64.0	.7	1.2	49.1	1.2	2.5
Other sciences, n.e.c.[2]	38.3	—	—	22.2	.2	.8

[1] Includes USDA, DOD, DOE, HHS, NASA, and NSF. The basic research obligations of these agencies to universities and colleges represent 99 percent of the Federal total to that sector.
[2] Not elsewhere classified.

SOURCE: National Science Foundation

applied research

Almost all agencies conducting R&D activities support applied research, much of it in their own laboratories. For almost all years on record, DOD has led other agencies by a substantial margin in support to this activity.

In the midfifties, the DOD share of the applied research total was as high as 65 percent, but as the sixties advanced, so did the R&D programs of other agencies, especially NASA and HEW. Between 1960 and 1965, the DOD share ranged between 50 percent and 60 percent, and by 1970, as the broad R&D efforts of DOD were reduced, the share fell to 34 percent (chart 13). Very little growth was shown in DOD support to applied research between 1970 and 1975, and a declining trend in terms of real performance was traced.

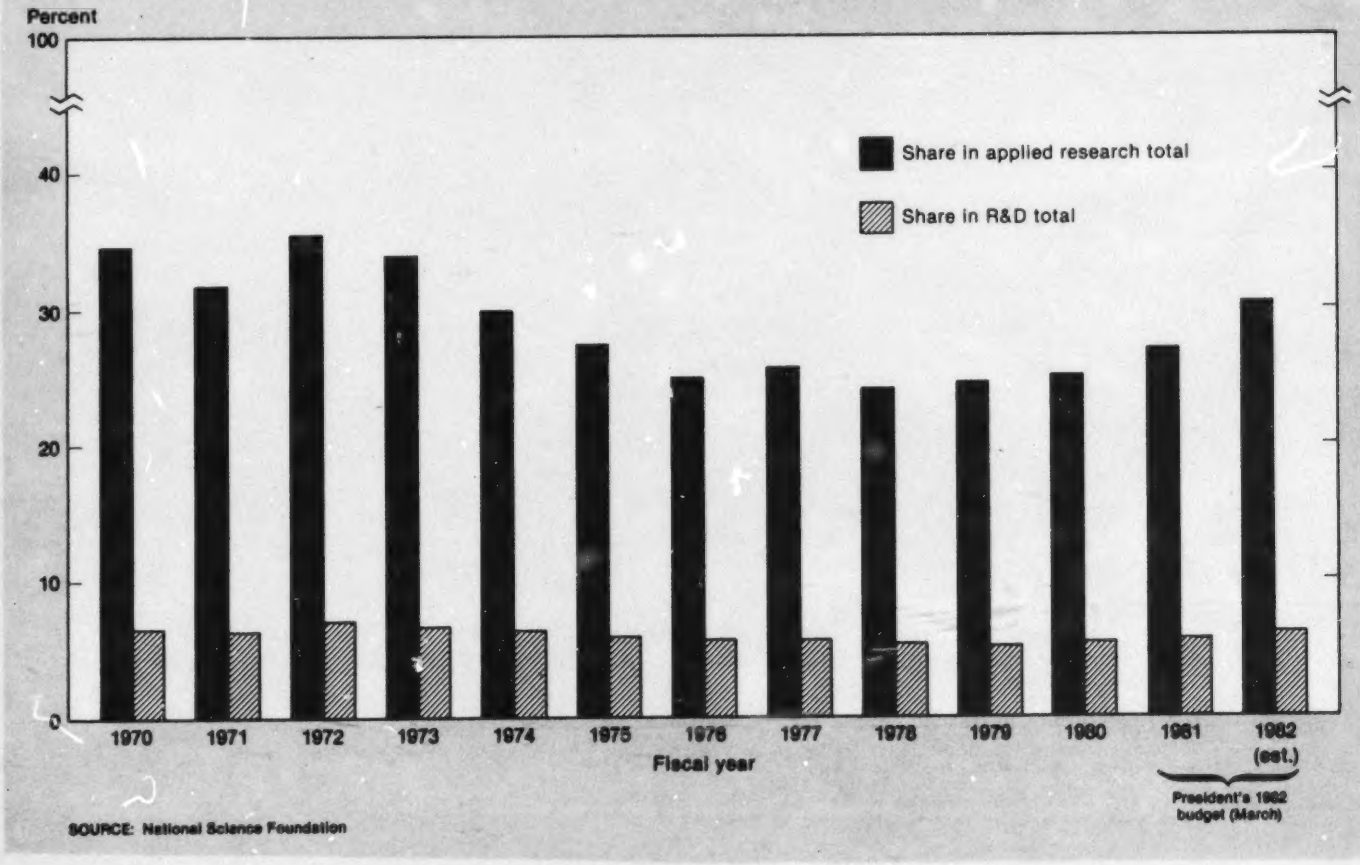
Between 1975 and the 1982 budget, however, an unmistakable and accelerating growth trend has become apparent. This trend reflects the DOD policy decision to place increasing funds in technology base, of which applied research is the major component. The genesis of new military technology and weapons systems is found in technology base.

Total Federal obligations for applied research grew only slightly in constant dollars between 1970 and 1975. Sizable gains in support from HEW did not make up for declines in support from DOD and NASA. Between 1975 and 1978, small real overall gains were registered. In 1978, for the first and only time, HEW support surpassed DOD support; DOD support has outpaced that of all the other agencies in the years since. The DOD share of the applied research total in the 1982 budget was expected to be 30 percent, compared with 24 percent in 1978.

The distribution of the increased dollars allotted by DOD to applied research between 1980 and 1982 appears mostly to affect industrial performers and intramural laboratories. The 1982 budget estimates showed an increase in the proportion of DOD applied research funds directed to industry from 51 percent to 57 percent between 1980 and 1982 and a decrease in the intramural share from 38 percent to 32 percent. DOD intramural efforts, although a lessening share of the agency's applied research total, were expected to grow substantially.

Universities and colleges received 6 percent of all DOD applied research obligations in 1980 and were expected to receive the same share in 1982 (a dollar

Chart 13. Share of DOD applied research within the Federal applied research and Federal R&D totals



SOURCE: National Science Foundation

amount less than one-half the DOD basic research amount earmarked for academia).

In periods of expansion, agencies tend to place added funds with extramural performers—in the case of DOD, to place funds for applied research with industrial organizations. In 1980, DOD accounted for 44 percent of all the Federal applied research obligations directed to industry; in 1982, DOD is expected to account for 53 percent of such funds. Much of this work will be associated with industrial development work for DOD. The effect in terms of the Federal applied research total will be a greater demand upon the resources of firms in aerospace, aircraft, electronics, and supporting industries than upon firms in the health and energy industries, as was the case in recent years.

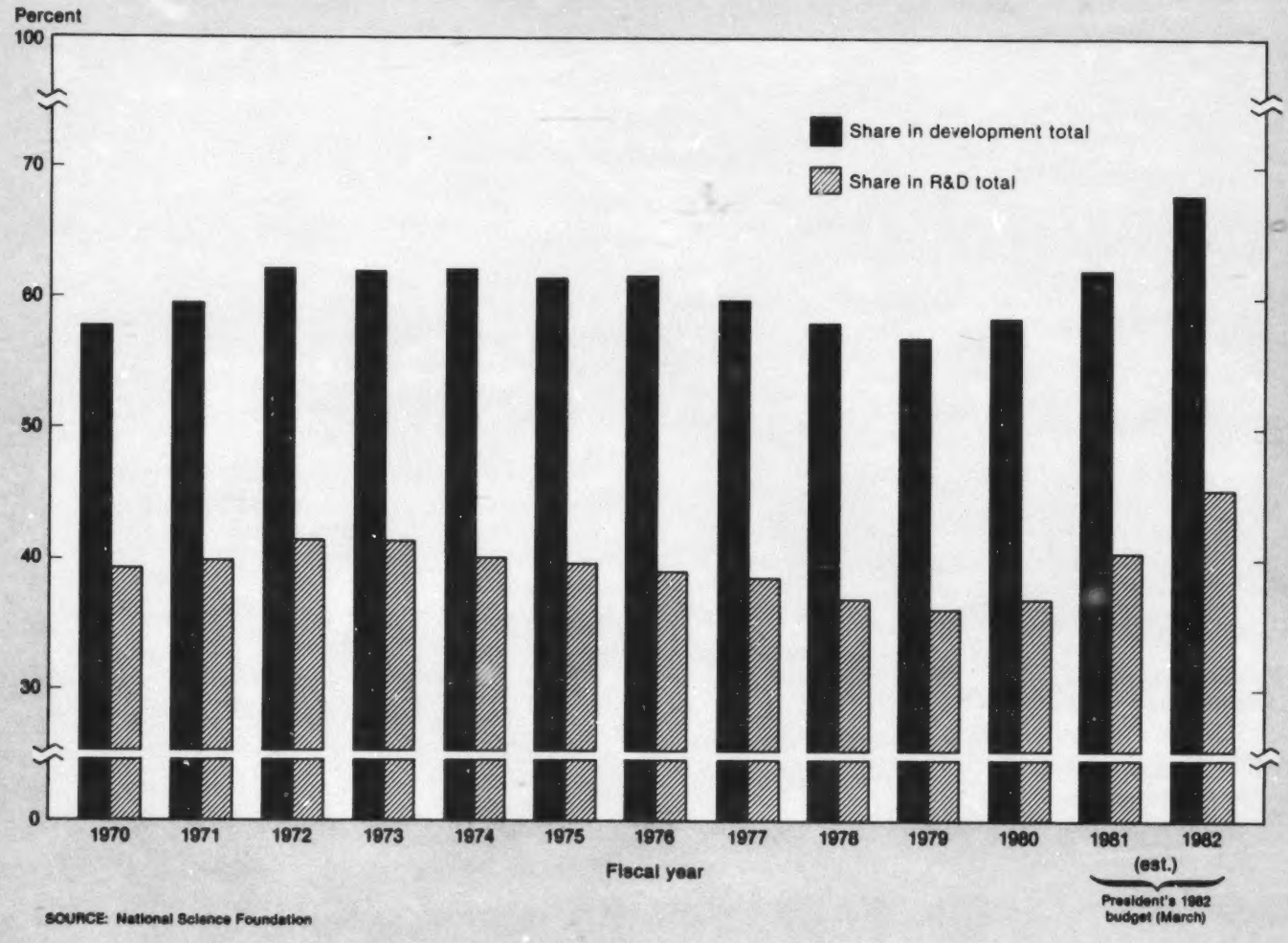
DOD support to applied research has been chiefly in engineering, especially electrical, mechanical, and aeronautical, followed by support to the physical sciences, especially physics. While increased funding can be expected in all fields, the DOD increases in these particular fields are expected to be substantial between 1980 and 1982.

development

The overwhelming importance of DOD development programs within the Federal R&D total is a matter of historical record. In almost every year of the seventies, for example, DOD development obligations accounted for approximately two-fifths of all Federal R&D obligations. The lowest share of that total, recorded in 1979, was 36 percent.

In DOD weapons programs, a progression takes place from the technology base area, which includes basic research in military sciences and applied research covering exploratory development and test-of-concept efforts, through the various stages of development of a weapons system leading to eventual procurement and deployment. The cost of the development phase is high, involving the use of spe-

Chart 14. Share of DOD development within the Federal development and Federal R&D totals



SOURCE: National Science Foundation

cialized materials, large capital resources, a range of engineering skills, and considerable technical manpower. The increasing sophistication of modern weapons plus inflation has pushed DOD development costs ever higher.

In the fifties and early sixties, when DOD R&D programs accounted for almost all Federal R&D funding, the DOD contribution to the Federal development total almost eclipsed all other efforts. In 1959, the share was 88 percent, while the contribution of AEC to the total amounted to 10 percent. Shortly thereafter, NASA entered the R&D area with vast development projects, most of them focused on a manned lunar landing. By 1963, the DOD share of the Federal development total had fallen to 62 percent, and the AEC share to 8 percent, while the NASA share had grown to 20 percent and continued to rise until 1967, when it was 34 percent. That year was also a high point in DOD development obligations, even though the share of DOD in the Federal development total had been reduced to 54 percent. In the next three years, DOD development support declined absolutely.

During the seventies, DOD increased development obligations each year, at least in current dollars. The toll of inflation was such, however, that real increases often did not occur from one year to the next. In 1975, for example, the obligations for development were 7 percent lower than in 1970 on a constant-dollar basis, and by 1979 development obligations were running only 5 percent ahead of 1975 in real terms. The effects of renewed defense funding began to be seen by 1980 in a real increase of 3 percent over 1979 and estimated real increases of 11 percent and 20 percent in 1981 and 1982, respectively.

In the 1982 budget period, more than ever, DOD development support swung the Federal R&D obligation total. The proposed current-dollar increase of 15 percent for all Federal R&D programs in the 1982 budget (March) development was almost entirely based on DOD R&D plans, including a projected 29-percent increase in DOD development programs. (The increase in development funding for NASA was 13 percent.) Between 1980 and 1982, the DOD share of the Federal development total was expected to grow from 58 percent to 68 percent (chart 14).

DOD was also expected to account for an increasing share of every development-performing sector. The DOD share of federally supported industrial development work was expected to grow from 61 percent to 69 percent; of intramural development, from 69 percent to 78 percent; of academic development efforts, from 32 percent to 43 percent.

These figures point toward a demand on resources in engineering and the physical sciences and in industries in aircraft, aerospace, electronics, and computer fields. Increases are also expected in Federal R&D support to certain States and geographic regions, especially California and States on the eastern seaboard with R&D performance capabilities.

section 4.

geographic distribution, 1980

In 1963, 1965, 1968, and annually since then, data have been collected on the geographic distribution of Federal R&D funds. In 1980, the 10 agencies participating in the geographic portion of the survey reported a total of $30.5 billion in R&D obligations, more than 95 percent of the Federal R&D total in that year.[19] These agencies also reported $1.5 billion in R&D plant obligations.

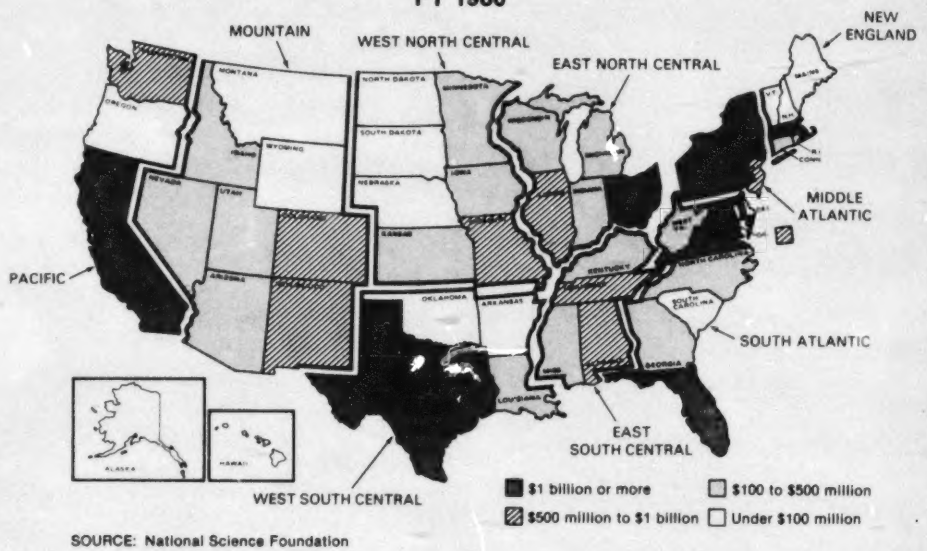
Data were reported on a prime contract basis, although additional data were obtained from NASA on the effects of first-tier subcontracting in 1980.[20] The NASA data indicate that when subcontracting is taken into account, most States show an increased share of the R&D total as a result of funds subcontracted out of California, the largest recipient State. Some change in ranking occurs, but the same States remain in the leader group.

The distribution by State of Federal R&D obligations for FY 1980 is shown in chart 15.

synopsis

- Every State and the District of Columbia received Federal R&D support.[21] California received the most—$7.1 billion; South Dakota the least—$9.9 million.
- Nine States—California, Maryland, Massachusetts, New York, Florida, Texas, Pennsylvania, Ohio, and Virginia—each showed more than $1 billion in Federal R&D obligations. Virginia was in this category in 1980 for the first time; the other eight States had been in this category in 1979.
- Nine States, including Colorado for the first time, were recipients of Federal R&D funds in the $500-million-to-$1-billion category.
- Eighteen States showed support levels between $100 million and $500 million.
- Fifteen States received under $100 million in obligations for Federal R&D performance.
- Forty-one States received larger amounts of support than in 1979. Of the 10 States showing decreases, 6 were in the under-$100-million category.
- Thirty-six States each received more than $100 million in Federal R&D funds. Twenty-two States each accounted for more than 1 percent of the Federal R&D total.

Chart 15. Distribution of total Federal R&D obligations by State: FY 1980



SOURCE: National Science Foundation

[19] The Departments of Agriculture, Commerce, Defense, Energy, the Interior, Transportation, and Health and Human Services; the Environmental Protection Agency; the National Aeronautics and Space Administration; and the National Science Foundation.

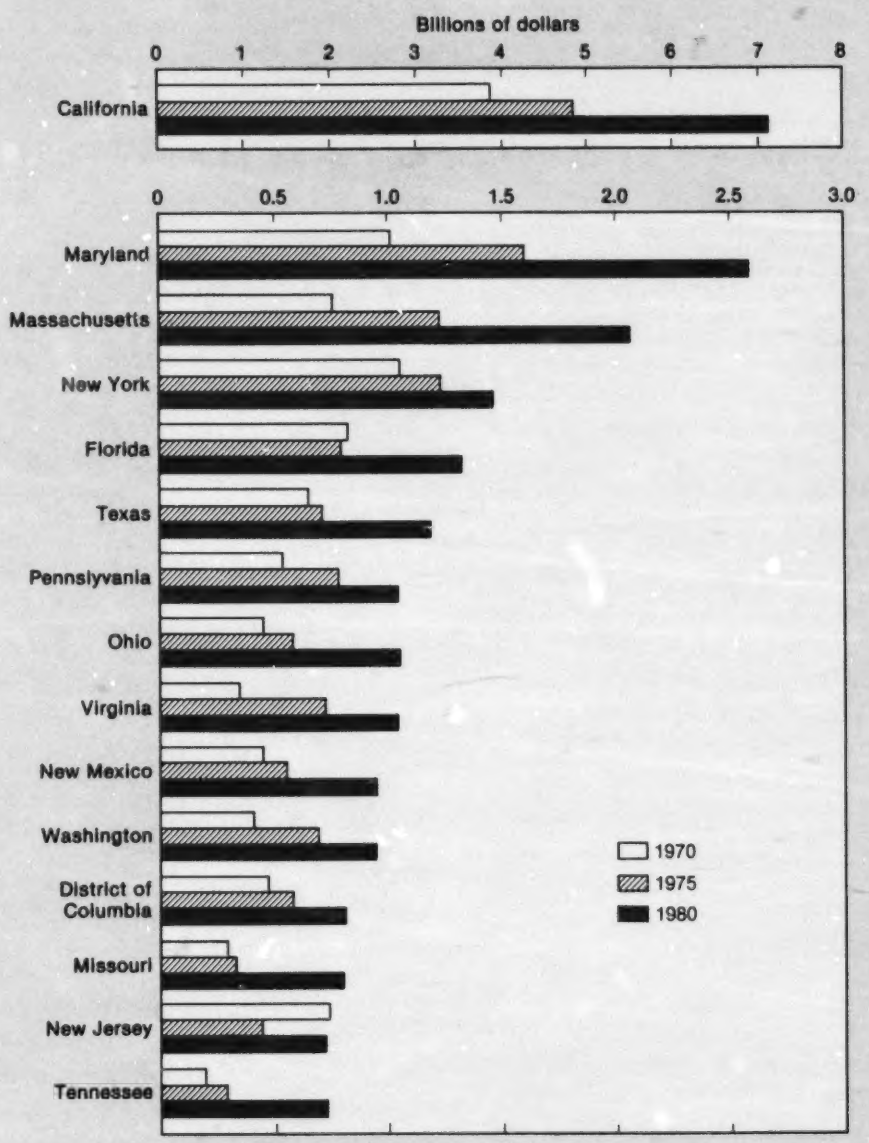
[20] See National Aeronautics and Space Administration, Office of Procurement, *Annual Procurement Report, Fiscal Year 1980* (Code HM-1) (Washington, D.C., 1980).

[21] For purposes of this analysis, the District of Columbia is considered a State.

the leading states

The 20 leading States together received 87 percent of total Federal R&D funds in 1980, and each of these received more than 1 percent of the Federal R&D total (table 9). Virtually the same pattern persisted throughout the 1969-80 period. Although rank orders may have changed somewhat throughout this period, the same States have appeared as leaders year after year. These are States that offer established industrial R&D capabilities and/or contain Federal intramural installations or university complexes with a range of well-developed research and technology specializations. They are the States most useful to analyze in terms of their R&D capabilities as well as in terms of the impact of Federal support on their economies and institutions (chart 16).

Chart 16. Federal R&D support to the 15 States leading in such support in 1980 for selected years



SOURCE: National Science Foundation

Table 9. Distribution of Federal R&D obligations to the 20 States leading in such support in fiscal year 1980 for selected years

[Dollars in millions]

State	1970	1974	1979	1980
Total	$14,981	$16,991	$27,917	$30,477
	Percent distribution			
Calif.	25.8%	24.0%	24.4%	23.4%
Md.	7.1	9.0	8.5	8.5
Mass.	5.1	7.0	7.4	6.8
N.Y.	8.2	6.0	4.9	4.8
Fla.	5.5	4.6	3.6	4.3
Tex.	4.3	3.8	4.1	3.9
Penn.	3.6	3.9	3.9	3.5
Ohio	3.1	3.3	3.8	3.5
Va.	2.4	3.8	3.4	3.4
N.M.	3.0	3.1	3.4	3.1
Wash.	2.8	3.8	3.1	3.1
D.C.	3.1	3.3	2.8	2.6
Mo.	1.9	2.3	2.8	2.6
N.J.	5.0	2.8	2.3	2.4
Tenn	1.3	1.4	2.3	2.4
Ill.	1.6	1.9	2.0	2.0
Colo.	1.8	1.9	1.6	1.9
Ala.	2.4	2.2	2.0	1.8
Conn.	1.1	1.4	1.2	1.5
Mich.	1.1	1.2	.9	1.2
All other States[1]	9.8	9.3	11.6	13.3

[1] Includes outlying areas and offices abroad.

SOURCE: National Science Foundation

California has been the leading recipient of Federal R&D obligations since the outset of geographic distribution studies in 1963. From 35 percent of the Federal R&D total in 1963, California's share dropped steadily to a low of 21 percent in 1972; it rose somewhat thereafter, and in 1980, was 23 percent. The long period of decline coincided generally with a decline in funding for NASA programs (after 1965) and either declines or only very slight increases in funding for AEC and DOD R&D programs. The 1980 funding level of $7.1 billion, 5 percent greater than 1979, was consistent with the previous 9-year average annual growth rate for this State (table 10). It reflected a large increase in funds from NASA, mostly in connection with the space shuttle program, and lesser increases in funds from DOE and HHS.

Table 10. Federal R&D obligations by geographic division and State for selected years

[Dollars in millions]

Division and State	1970	1979	Average annual percent change 1970-79	1980	Percent change 1979-80
Total, all States	$14,980.8	$27,916.8	7.2%	$30,477.3	9.2%
Pacific	4,404.1	7,855.6	6.6	8,272.8	5.3
Alaska	43.2	45.9	0.7	42.5	-7.4
California	3,871.1	6,804.0	6.5	7,138.0	4.9
Hawaii	43.8	40.8	-0.8	42.6	4.3
Oregon	33.8	100.1	12.8	97.9	-2.2
Washington	412.2	864.8	8.6	951.8	10.1
South Atlantic	2,899.3	5,726.9	7.9	6,430.2	12.3
Delaware	16.3	14.4	-1.4	20.8	44.3
District of Columbia	468.5	768.4	5.7	807.0	5.0
Florida	824.8	1,017.3	2.4	1,323.5	30.1
Georgia	72.3	184.4	11.0	169.8	-7.9
Maryland	1,063.4	2,359.8	9.3	2,595.0	10.0
North Carolina	63.9	220.9	14.8	227.7	3.1
South Carolina	17.8	114.3	22.9	87.5	23.5
Virginia	352.7	940.3	11.5	1,047.1	11.4
West Virginia	19.6	107.2	20.7	152.0	41.9
Middle Atlantic	2,516.0	3,112.3	2.4	3,260.0	4.7
New Jersey	741.7	649.3	-1.5	729.4	12.3
New York	1,235.6	1,363.1	1.1	1,471.2	7.9
Pennsylvania	538.8	1,099.9	8.3	1,059.4	-3.7
New England	1,000.8	2,685.1	11.6	2,814.4	4.8
Connecticut	160.0	328.4	8.3	470.3	43.2
Maine	13.3	23.1	6.4	25.9	12.3
Massachusetts	760.9	2,062.3	11.7	2,066.7	0.2
New Hampshire	27.3	94.1	14.8	50.2	-46.7
Rhode Island	29.9	140.7	18.8	149.9	6.6
Vermont	9.5	36.5	16.2	51.3	40.4
Mountain	1,136.7	2,262.7	7.9	2,568.2	13.5
Arizona	72.8	201.4	12.0	334.6	66.1
Colorado	274.1	442.2	5.5	573.7	29.7
Idaho	75.0	147.1	7.8	147.7	0.4
Montana	11.6	41.6	15.2	45.7	9.6
Nevada	190.9	222.1	1.7	214.5	-3.4
New Mexico	445.0	955.5	8.9	954.2	-0.1
Utah	61.1	211.6	14.8	243.9	15.3
Wyoming	7.2	41.0	21.4	53.9	31.4
East North Central	1,038.8	2,097.8	8.1	2,316.2	10.4
Illinois	239.6	547.2	9.6	599.9	9.6
Indiana	91.9	122.0	3.2	162.4	33.1
Michigan	162.8	264.4	5.5	377.5	42.8
Ohio	457.3	1,053.2	9.7	1,054.7	0.1
Wisconsin	87.1	111.0	2.7	121.7	9.6
West North Central	475.4	1,277.8	11.6	1,618.5	26.7
Iowa	32.7	84.9	11.2	121.7	43.4
Kansas	16.6	136.3	26.3	353.6	159.3
Minnesota	109.3	202.8	7.1	261.6	29.0
Missouri	291.2	778.9	11.6	801.6	2.9
Nebraska	10.6	31.3	12.7	31.6	1.0
North Dakota	8.9	33.4	15.9	38.7	15.6
South Dakota	6.1	10.2	5.9	9.9	-3.1
West South Central	834.9	1,454.2	6.4	1,585.4	9.0
Arkansas	9.8	37.3	16.0	30.0	-19.5
Louisiana	146.5	209.1	4.0	269.8	29.0
Oklahoma	29.5	70.1	10.1	94.5	34.7
Texas	649.1	1,137.7	6.4	1,191.3	4.7
East South Central	599.7	1,347.3	9.4	1,492.8	10.8
Alabama	357.2	559.6	5.1	552.7	-1.2
Kentucky	20.4	43.0	8.6	107.9	150.8
Mississippi	28.3	100.7	15.2	109.3	8.6
Tennessee	193.8	644.1	14.3	722.9	12.2
Outlying areas	17.3	39.4	9.6	45.3	14.9
Offices abroad	56.8	57.7	0.2	73.5	27.6

SOURCE: National Science Foundation

Maryland has increased its share of the total from 6 percent in 1963 to 9 percent, or $2.6 billion, in 1980. This steady increase in funding is largely attributable to the numerous Federal R&D installations located in this State, which has always dominated in terms of R&D obligations for intramural performance. The intramural sector accounts for approximately two-thirds of all Federal R&D funds directed to Maryland performers. Included among intramural installations are the National Institutes of Health (HHS), the Naval Air Test Center (DOD), the Army Edgewood Arsenal Laboratories (DOD), the National Bureau of Standards (Commerce), the Goddard Space Flight Center (NASA), and the Agricultural Research Center (USDA). In 1980, the increase of 10 percent in R&D funds received was consistent with the previous 9-year average annual growth rate.

Massachusetts, which received $2.1 billion in 1980, has ranked third in Federal R&D support since 1973. The share has been approximately 7 percent since 1978. DOD funds provide approximately 70 percent of this State's total Federal R&D support. DOD and DOE have been responsible for most of the increases in funds to Massachusetts over the past several years, but the increases from these agencies in 1980 were not as substantial as in prior years. Most support to Massachusetts is directed to industrial performers, and much of the rest to universities and colleges. HHS and DOD make extensive use of university research skills in Massachusetts.

New York, which has maintained fourth place since 1974, has shown a decline in its share of the total—from 7 percent in 1969 to somewhat under 5 percent in 1980 when it received $1.5 billion. DOD, HHS, and DOE accounted for nearly 90 percent of total Federal R&D obligations to New York in 1980. Almost one-half of the funding in 1980 was directed to industrial firms and one-fourth to universities and colleges. In recent years, support to most performers in the State have shown a rising trend, largely from DOD, HHS, and DOE programs. In 1980, New York showed an 8-percent increase in R&D funds over 1979, largely from relatively sharp increases in DOD, HHS, and DOE support. This represented a significant change in R&D funding from the previous 9-year average annual growth rate of 1.1 percent.

Florida reflected an increase of $306 million in 1980 over 1979, or 30 percent, bringing the State total to $1.3 billion. This rate of change compared with a 2.4-percent average annual gain for the previous 9-year period. Florida, thus, moved to fifth place in receipt of Federal R&D funds in 1980 from sixth place in 1978 and 1979. The State has remained quite stable in terms of its share of the Federal R&D total, ranging from a high of 6 percent in 1970 to the current level of 4 percent. The performance of industrial firms accounted for more than one-half of the Federal R&D support in 1980. An increase of 43 percent in funding to this sector was largely attributable to DOD. DOD and NASA have also increased their R&D obligations in the intramural sector within the State. Florida is the site of such test centers as the Kennedy Space Center, Eglin Air Force Base, and the Eastern Test Range.

The leading four states—California, Maryland, Massachusetts, and New York—remained in the same rank order in the 1974-80 period, while the States that received less than these four shifted their positions. Other States among the leading 15 in the 1970-80 decade were Texas, Pennsylvania, New Mexico, Ohio, Washington, and Virginia.

relative rates of growth

Of the leading 20 States in 1980, the most rapid rates of growth in Federal R&D support have been shown by Massachusetts and Virginia in the group receiving $1 billion or more and by Missouri, Tennessee, and Connecticut in the group receiving between $375 million and $999 million (table 11). The 10.5-percent average annual growth in Massachusetts in the seventies reflects DOD support to industrial firms as well as HHS support to universities. The growth rate of 11.3 percent in Virginia was influenced by DOD support to industry, especially by Navy ship-related R&D contracts. Intramural work in Virginia, however, has been somewhat more heavily funded than industrial work; typical installations are the Army laboratories at Fort Belvoir, the NASA Langley Research Center at Hampton, and the NASA Wallops Flight Center at Wallops Island.

In the 1970-80 period, New York showed the slowest average annual growth rate of the leading 10 States (1.8 percent), reflecting 1970-73 declines in NASA support to industry and HHS support to universities. New Jersey, now 14th in rank, showed a slight average annual decrease; it is the only State in the leading group with lower R&D funding from Federal agencies in 1980 than in 1970.

Table 11. Relative growth in the fiscal year 1970-80 period in Federal R&D obligations to the 20 States leading in such support in fiscal year 1980

[Dollars in millions]

State	1970	1980	Average annual percent change 1970-80
Total, all States	$14,980.9	$30,477.3	7.5%
California	3,871.1	7,138.0	6.3
Maryland	1,063.4	2,595.0	9.3
Massachusetts	760.9	2,066.7	10.5
New York	1,236.0	1,471.2	1.8
Florida	824.8	1,325.5	4.9
Texas	649.1	1,191.3	6.3
Pennsylvania	538.8	1,059.4	7.0
Ohio	457.3	1,054.7	8.7
Virginia	352.8	1,047.1	11.5
New Mexico	445.0	954.2	7.9
Washington	412.2	951.8	8.7
District of Columbia	468.5	807.0	5.6
Missouri	291.2	801.6	10.7
New Jersey	741.7	729.4	-.2
Tennessee	193.8	722.9	14.1
Illinois	239.6	599.9	9.6
Colorado	274.1	573.7	7.7
Alabama	357.2	552.7	4.5
Connecticut	160.0	470.3	11.4
Michigan	162.8	377.5	8.8
All other States[1]	1,406.9	3,870.8	10.7

[1] Includes outlying areas and office abroad.

SOURCE: National Science Foundation

distribution of funds by performer

Federal agencies seeking specific kinds of research or development competence to implement their missions have turned to existing organizations with specialized characteristics within certain States. These States contain aircraft, aerospace, and electronics industries, concentrations of

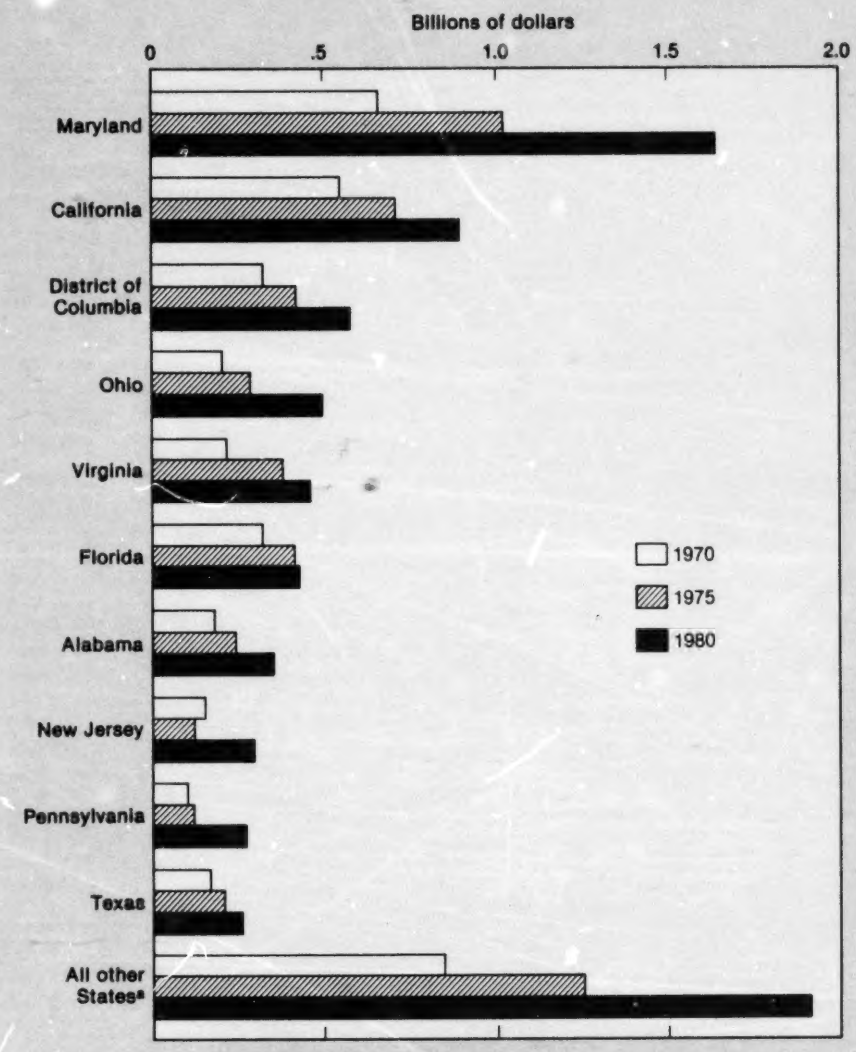
university research talent, including modern medical research teams, and/or geographic areas safe for testing missiles, aircraft, spacecraft, and explosives.

When States are compared by performing sectors, contrasting patterns of rank can be seen (chart 17). Those States that remain among the four or five leaders in receipt of Federal R&D funds year after year have a strong balance of capabilities. Thus, in 1980, as in prior years, California led in R&D obligations directed to industrial firms, universities and their associated FFRDC's, and other nonprofit institutions. Maryland led all the States in Federal intramural support for the same period and was also a leader in Federal R&D support to industry and universities and colleges. Massachusetts was second after California in support to industry, universities and colleges, and other nonprofit institutions.

The continuance of strong Federal R&D support usually depends on performer capability in several sectors. Some States, however, receive R&D funds because they offer particular advantages, such as low populations and flat surfaces for weapons testing (Nevada) or high elevations and absence of manmade light for astronomical observation (West Virginia).

Concentrations of Federal R&D funds among a few States are sometimes found in areas where the number of performers in a sector are relatively few. Thus, in the case of university-administered FFRDC's, approximately 98 percent of the Federal R&D funds were directed to 10 States in 1980, and in the case of other nonprofit institutions, 72 percent of the funds were directed to the top 10 States. In intramural performance, about 75 percent of total funds were distributed to the leading 10 States, in industrial performance and 72 percent to the leading 10 States. By contrast, in the case of universities and colleges, which are widely distributed, only 62 percent of the Federal R&D funds were allotted to the leading 10 States in 1980. These ratios are very similar to the ratios in earlier years.

Chart 17. Federal R&D obligations to intramural performers in the 10 States leading in such support in FY 1980 for selected years



[a]Includes outlying areas and offices abroad.

SOURCE: National Science Foundation

factors in r&d performing strength

R&D obligations can be ranked by State and compared with such measures of national resources as population, total personal income, total Federal taxes, and doctoral scientists and engineers (table 12), p. 26. Although no direct causal relationships can be inferred, the data indicate that most of the top recipient R&D States in 1980 also had the larger shares of such resources. The exception was New Mexico, which ranked 10th in Federal R&D obligations in 1980 but was very low on the scale of population, personal income, taxes, and science and engineering personnel.

Table 12. Distribution of Federal R&D obligations by State compared with other national indicators by State: fiscal year 1980

State	Total Federal R&D obligations		Population		Total personal income[2]		Total Federal taxes[3]		Doctoral scientists and engineers[6]	
	Rank	Percent of total	Rank	Percent of total	Rank	Percent of total	Rank	Percent of total	Rank	Percent of total
United States, total	$30,477 million		[1]227 million		$2,162,936 million		$467,230 million		332 thousand	
California	1	23.42	1	10.45	1	12.00	2	11.19	1	11.95
Maryland	2	8.51	18	1.86	16	2.04	10	2.66	9	3.86
Massachusetts	3	6.78	11	2.53	10	2.69	12	2.53	6	4.24
New York	4	4.83	2	7.75	2	8.35	1	11.74	2	9.85
Florida	5	4.34	7	4.34	8	4.10	9	3.00	13	2.26
Texas	6	3.91	3	6.28	3	6.29	3	7.31	3	4.95
Pennsylvania	7	3.48	4	5.24	5	5.19	5	5.49	4	4.78
Ohio	8	3.46	6	4.76	6	4.73	6	5.43	8	4.03
Virginia	9	3.44	14	2.36	11	2.33	20	1.60	12	2.86
New Mexico	10	3.13	37	.57	37	.47	43	.26	25	1.17
Washington	11	3.12	20	1.82	18	1.97	18	1.68	15	2.08
District of Columbia	12	2.65	47	.28	43	.36	([4])	([4])	10	3.50
Missouri	13	2.63	15	2.17	14	2.05	11	2.56	22	1.63
New Jersey	14	2.39	9	3.25	9	3.73	8	3.79	7	4.09
Tennessee	15	2.37	17	2.03	22	1.64	24	1.18	21	1.69
Illinois	16	1.97	5	5.04	4	5.57	4	6.99	6	4.47
Colorado	17	1.88	28	1.27	24	1.34	22	1.52	16	1.90
Alabama	18	1.81	22	1.72	23	1.35	28	.82	30	.94
Connecticut	19	1.54	25	1.37	20	1.69	14	2.18	19	1.80
Michigan	20	1.24	8	4.09	7	4.27	7	4.78	11	3.22
Kansas	21	1.16	32	1.04	30	1.09	26	.97	35	.71
Arizona	22	1.10	29	1.20	29	1.11	30	.68	27	1.08
Louisiana	23	.89	19	1.86	21	1.65	23	1.74	24	1.22
Minnesota	24	.86	21	1.80	19	1.84	13	2.30	17	1.86
Utah	25	.80	36	.64	36	.52	38	.33	33	.82
North Carolina	26	.75	10	2.59	13	2.13	16	1.90	14	2.22
Nevada	27	.70	43	.35	41	.40	39	.33	51	.20
Georgia	28	.56	13	2.41	15	2.04	21	1.59	23	1.49
Indiana	29	.53	12	2.42	12	2.27	15	2.00	20	1.74
West Virginia	30									
Rhode Island	31	.49	40	.42	39	.41	35	.37	39	.52
Idaho	32	.48	41	.42	44	.35	41	.28	41	.45
Iowa	33	.40	27	1.29	27	1.26	27	.84	29	.94
Wisconsin	34	.40	16	2.08	17	2.04	17	1.86	18	1.80
Mississippi	35	.36	31	1.11	33	.77	36	.34	36	.63
Kentucky	36	.35	23	1.62	25	1.29	25	1.15	31	.89
Oregon	37	.32	30	1.16	28	1.14	29	.79	26	1.16
Oklahoma	38	.31	26	1.34	26	1.28	19	1.65	28	.95
South Carolina	39	.29	24	1.38	31	1.05	32	.63	34	.77
Wyoming	40	.18	50	.21	49	.24	48	.15	47	.24
Vermont	41	.17	49	.23	51	.19	50	.10	45	.30
New Hampshire	42	.16	42	.41	42	.39	42	.27	46	.29
Montana	43	.15	44	.35	45	.31	45	.17	42	.37
Hawaii	44	.14	39	.43	38	.45	40	.31	40	.50
Alaska	45	.14	51	.18	50	.24	47	.15	50	.21
North Dakota	46	.13	46	.29	47	.26	46	.15	49	.22
Nebraska	47	.10	35	.69	35	.68	31	.67	37	.62
Arkansas	48	.10	33	1.01	32	.77	34	.41	44	.34
Maine	49	.09	38	.50	40	.41	44	.22	43	.35
Delaware	50	.07	48	.26	46	.29	33	.46	32	.86
South Dakota	51	.03	45	.31	48	.25	49	.14	48	.23
Outlying areas and offices abroad	—	.39	—	—	—	—	—	[5].45	—	.22

[1] Provisional estimate of resident population as of July 1, 1980. See Department of Commerce, Bureau of the Census, *Current Population Reports*, Series P-25.

[2] Data shown as of December 31, 1980. See Department of Commerce, Bureau of Economic Analysis, *U.S. Department of Commerce News*, August 9, 1981 (BEA 81-45).

[3] Includes individual income and employment taxes, corporate income, excise, estate and gift taxes (minus refunds, excluding interest). See U.S. Department of the Treasury, *Statistical Appendix to the Annual Report of the Secretary of the Treasury on the State of the Finances for the Fiscal Year Ended September 30, 1980*.

[4] Included in Maryland tax figures.

[5] Collections from and refunds to U.S. taxpayers in Puerto Rico, Canal Zone, and in foreign countries.

[6] Unpublished data from the Division of Science Resources Studies, National Science Foundation.

SOURCES: Department of Commerce, Department of the Treasury, and the National Science Foundation

r&d plant

Three agencies led in R&D plant obligations in 1980—DOE, DOD, and NASA. The support by DOE accounted for 68 per cent of all such support. In the case of DOD and NASA, R&D plant obligations are underreported because a large part of the costs associated with R&D plant is not separately broken out, but is included within R&D costs reported for extramural performers. Thus, in most States for which R&D plant obligations are shown, the leading agency is DOE (table 13).

For the 10th consecutive year, California received the largest share of R&D plant support—approximately 25 percent of the total. Most of the funding was provided by DOE, DOD, and NASA. Most of the DOE R&D plant support was directed to the E.O. Lawrence Livermore Laboratory (University of California) and the E.O. Lawrence Berkeley Laboratory (University of California).

R&D plant obligations from DOE to New Mexico funded work at the Combustion Research Facility at the Sandia Laboratory and work at the high-intensity Neutron Source Facility at Los Alamos.

Continuation of DOE work on the high-performance Fuel Laboratory, Fuel Storage Facility, and Fast Flux Test Facility at the Hanford Engineering Development Laboratory in Richland, Washington, accounted for nearly 83 percent of the R&D plant total in the State of Washington.

Table 13. Federal obligations for R&D plant in the 10 States leading in such support by agency: fiscal year 1980

[Dollars in millions]

	Total	DOE	DOD	NASA	USDA	HHS	DOT	NSF	Others[1]
Total	$1,533	$1,024	$208	$159	$57	$31	$23	$19	$12
California	377	238	76	48	4	1	6	5	[2]
New Mexico	169	159	10	—	1	—	—	—	[2]
Washington	128	123	—	—	[2]	5	—	[2]	[2]
New York	91	85	[2]	—	2	1	—	3	1
Tennessee	80	70	9	—	[2]	1	—	—	—
Illinois	72	67	[2]	—	4	—	—	—	[2]
New Jersey	61	52	3	—	—	—	6	—	—
Maryland	53	[2]	21	3	7	22	—	—	[2]
Alabama	48	34	—	13	[2]	—	—	—	[2]
Florida	47	—	12	30	1	—	—	3	[2]
All other States[3]	403	196	76	65	37	1	11	8	9

[1] Includes the Departments of Commerce and the Interior.
[2] Less than $500,000.
[3] Includes outlying areas and office abroad.

SOURCE: National Science Foundation

appendixes

a. technical notes
b. federally funded research and development centers
c. statistical tables

NOTE

The detailed statistical tables for this volume have been published separately under one cover (NSF 81-325). Included on pp. 45-48 in this volume are detailed statistical tables C-1, C-2, and C-3, as well as a complete listing of all the tables.

Detailed statistical tables may be obtained gratis from the National Science Foundation, Washington, D.C. 20550.

appendix a

technical notes

scope and method

Between March and July 1981, a total of 36 Federal agencies and their subdivisions—95 individual respondents—submitted data in response to the *Annual Survey of Federal Funds for Research and Development*, Volume XXX, conducted by the National Science Foundation (NSF) with initital distribution in February 1981. In nearly all cases the data reported by the agencies were in terms of obligations and outlays incurred, or expected to be incurred, regardless of when the funds were appropriated or whether they were identified in the respondents' budgets specifically for R&D activities. The exception was the National Aeronautics and Space Administration (NASA), for which the same kinds of transactions were reported in terms of budget plan, which approximates obligations.

Federal agencies provided R&D data earlier to the Office of Management and Budget (OMB) for inclusion in "Special Analysis K: Research and Development" in *The Budget of the United States Government, Fiscal Year 1982*, as part of the budget document presented to Congress in January 1981. The incoming administration then revised the 1982 budget as part of a broad anti-inflationary and economic revitalization program. In April OMB issued a paper, "Research and Development Revisions to the Fiscal Years 1981 and 1982 Budgets, March 1981," that summarized proposed rescissions in FY 1981 R&D programs and budget amendments to FY 1982 R&D programs for leading R&D support agencies. The agencies, in reporting to the *Federal Funds* survey for fiscal years 1980, 1981, and 1982, incorporated these revisions. The R&D data in the OMB documents and in the *Federal Funds* survey were based on the same definitions and are reconcilable, but the data in the *Federal Funds* survey are classified in greater detail and cover smaller R&D support agencies not covered by OMB.

definitions

The definitions are essentially unchanged from prior *Federal Funds* surveys.

1. research, development, and r&d plant

This heading includes all direct, indirect, incidental, or related costs resulting from or necessary to research, development, and R&D plant, regardless of whether the research and development are performed by a Federal agency (intramurally) or performed by private individuals and organizations under grant or contract (extramurally). Research and development exclude routine product testing, quality control, mapping and surveys, collection of general-purpose statistics, experimental production, and the training of scientific personnel.

a. **Research** is systematic study directed toward fuller scientific knowledge or understanding of the subject. Research is classified as either basic or applied according to the objectives of the sponsoring agency.

In **basic research** the objective of the sponsoring agency is to gain fuller knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications toward processes or products in mind.

In **applied research** the objective of the sponsoring agency is to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met.

b. **Development** is systematic use of the knowledge or understanding gained from research, directed toward the production of useful materials, devices, systems, or methods, including design and development of prototypes and processes. It excludes quality control, routine product testing, and production.

c. **R&D plant** (R&D facilities and fixed equipment, such as reactors, wind tunnels, and radio telescopes) includes acquisition of, construction of, major repairs to, or alterations in structures, works, equipment, facilities, or land, for use in R&D activities at Federal or non-Federal installations. Excluded from the R&D plant category are expendable equipment and office furniture and equipment. Obligations for foreign R&D plant are limited to Federal funds for facilities located abroad and used in support of foreign research and development.

2. obligations and outlays

a. **Obligations** represent the amounts for orders placed, contracts awarded, services received, and similar transactions during a given period, regardless of when the funds were appropriated and when future payment of money is required.

b. **Outlays** represent the amounts for checks issued and cash payments made during a given period, regardless of when the funds were appropriated.

The obligations and outlays reported cover all transactions from all funds available to an agency from direct appropriations, trust funds, or special account receipts, corporate income, or other sources, including funds appropriated by the President, that the agency has received or expects to receive. The amounts reported for each year reflect obligations and outlays for that year regardless of when the funds were originally authorized or received and regardless of whether they were appropriated, received, or identified in the agency's budget specifically for research, development, or R&D plant.

An agency making a transfer of funds to another agency includes such transfers in its report of obligations and outlays. The receiving agency does not report, for purposes of this survey, funds transferred to it from another agency. Similarly, a subdivision of an agency that transfers funds to another subdivision within that agency reports such obligations or outlays as its own.

Obligations and outlays for work performed in foreign countries include funds directly available to Federal agencies and special foreign currencies separately appropriated. The latter currencies are derived largely from provisions of Public Law 480, 1954, as amended.

3. cost coverage

Funds reported for research and development reflect full costs. In addition to costs of specific R&D projects, the applicable overhead costs are also included. The amounts reported include the costs of planning and administering R&D programs, laboratory overhead, pay of military personnel, and departmental administration.

4. fiscal year

The fiscal year in the Federal Government accounting period begins October 1 of a given year and ends September 30 of the following year; thus, FY 1980 began on October 1, 1979, and ended September 30, 1980.

5. agency

An agency is an organization of the Federal Government whose principal executive officer reports to the President. The only exception is the Library of Congress, also included in the survey, whose executive officer reports to the Congress. The term subdivision refers to any major organizational unit of a reporting agency, such as a bureau, administration, office, or service.

6. performers

Performers are either intramural organizations accomplishing operating functions or extramural organizations or persons receiving support or providing services under a contract or grant.

a. **Intramural performers:** Agencies of the Federal Government. Their work is carried on directly by their own personnel. Obligations reported under this category are for activities performed directly by a reporting agency, or they represent funds that the agency transfers to another Federal agency for performance of work. The ultimate performer must be a Federal agency. If the ultimate performer is *not* a Federal agency, the funds so transferred are reported by the transferring agency under the appropriate extramural performer category (industrial firms, universities and colleges, other nonprofit institutions, etc.). Intramural performance includes the costs of supplies and equipment, essentially of an "off-the-shelf" nature, that are procured for use in intramural research and development. The cost of Federal personnel engaged in planning and administering intramural and extramural R&D programs are also included as part of the intramural performance total.

b. **Extramural performers:** All organizations outside the Federal sector that perform with Federal funds under contract or grant. Only those costs associated with actual extramural R&D performance are reported, but these would include costs of materials and supplies to carry out R&D activities. Costs of "off-the-shelf" supplies and equipment procured from extramural suppliers and required to support intramural research and development are considered as part of the costs of intramural performance and not as part of the costs of extramural performance. Extramural performers are identified as follows:

i. **Industrial firms:** Those organizations that may legally distribute net earnings to individuals or to other organizations.

ii. **Universities and colleges:** Institutions engaged primarily in providing resident and/or accredited instruction for at least a 2-year program above the secondary school level. Included are colleges of liberal arts; schools of arts and sciences; professional schools, as in engineering and medicine, including affiliated hospitals; associated research institutes; and agricultural experiment stations.

iii. **Other nonprofit institutions:** Private organizations other than educational institutions, no part of whose net earnings inure to the benefit of a private stockholder or individual, and other private organizations organized for the exclusive purpose of turning over their entire net earnings to such nonprofit institutions.

iv. **Federally funded research and development centers (FFRDC's):** R&D-performing organizations exclusively or substantially financed by the Federal Government that are supported by the Federal Government either to meet a particular R&D objective or, in some instances, to provide major facilities at universities for research and associated training purposes. Each center is administered either by an industrial firm, a university, or another nonprofit institution.

In general, all of the following criteria are met by an organization before it is included in the FFRDC category: (1) its primary activities include one or more of the following: basic research, applied research, development, or management of research and development (specifically excluded are organizations engaged primarily in routine quality control and testing, routine service activities, production, mapping and surveys, and information

dissemination); (2) it is a separate operational unit within the parent organization or is organized as a separately incorporated organization; (3) it performs actual research and development or R&D management either upon direct request of the Federal Government or under a broad charter from the Federal Government, but in either case under the direct monitorship of the Federal Government; (4) it receives its major financial support (70 percent or more) from the Federal Government, usually from one agency; (5) it has, or is expected to have, a long-term relationship with its sponsoring agency (about five years or more), as evidenced by specific obligations assumed by it and the agency; (6) most or all of its facilities are owned by or are funded under contract with the Federal Government; and (7) it has an average annual budget (operating and capital equipment) of at least $500,000.

v. **State and local governments:** State and local government agencies, excluding State and local universities and colleges, agricultural experiment stations, medical schools, and affiliated hospitals. (Federal R&D funds obligated directly to such State and local educational institutions are included under the universities- and -colleges category in this survey.) Research and development under the State and local government category are performed either directly by State or local agencies or by other organizations under grant or contract from such agencies. Regardless of the ultimate performer, Federal R&D funds directed to State and local government are reported under the State- and -local government category and no other.

vi. **Foreign performers:** Foreign citizens, organizations, or governments, as well as international organizations, such as NATO, UNESCO, WHO, performing work abroad financed by the Federal Government. Excluded are payments to U.S. agencies, organizations, or citizens performing research and development abroad for the Federal Government; the survey does not seek information on "offshore" payments. Also excluded are payments to foreign scientists performing in the United States.

vii. **Private individuals:** Individuals receiving a Federal R&D grant or contract award directly; in this case obligations are reported under "industrial firms."

7. fields of science

The fields of science in this survey are divided into eight broad field categories, each of them consisting of a number of detailed fields. The broad fields are life sciences, psychology, physical sciences, environmental sciences, mathematics and computer sciences, engineering, social sciences, and other sciences not elsewhere classified. The following listing presents the fields grouped under each of the broad fields, together with illustrative disciplines.

a. **Life sciences** consist of five detailed fields: biological (excluding environmental), environmental biology, agricultural, medical, and life sciences not elsewhere classified. The illustrative disciplines provided below under each of these detailed fields are not intended to be sharp definitions; they represent examples of disciplines generally classified under a given detailed field. A discipline, however, may be classified under another detailed field when the major emphasis is elsewhere. Research in biochemistry could be reported as biological, agricultural, or medical, depending on the orientation of the project. Human biochemistry would be classified under biological, but animal biochemistry or plant biochemistry would be under agricultural. Examples of disciplines under each of the detailed fields are as follows:

Biological (excluding environmental): anatomy; biochemistry; biology; biometry and biostatistics; biophysics; botany; cell biology; entomology and parasitology; genetics; microbiology; neuroscience (biological); nutrition; physiology; zoology; other biological, n.e.c.[1]

Environmental biology: ecosystem sciences; evolutionary biology; limnology; physiological ecology; population biology; population and biotic community ecology; systematics; other environmenal biology, n.e.c.[1]

Agricultural: agronomy; animal sciences; food science and technology; fish and wildlife; forestry; horticulture; plant sciences; soils and soil science; phytopathology; phytoproduction; agriculture, general; other agriculture, n.e.c.[1]

Medical: internal medicine; neurology; obstetrics and gynecology; ophthalmology; otolaryngology; pediatrics; preventive medicine; pathology; pharmacology; psychiatry; radiology; surgery; dentistry; pharmacy; veterinary medicine; other medical, n.e.c.[1]

Life sciences, n.e.c.[1]

b. **Psychology** deals with behavior, mental processes, and individual and group characteristics and abilities. Psychology is divided into three categories: biological aspects, social aspects, and psychological sciences not elsewhere classified. Examples of disciplines under each of these fields are as follows:

Biological aspects: experimental psychology; animal behavior; clinical psychology; comparative psychology; ethology.

Social aspects: social psychology; education, personnel, vocational psychology, and testing; industrial and engineering psychology; development and personality.

Psychological sciences, n.e.c.[1]

c. **Physical sciences** are concerned with understanding of the material universe and its phenomena. They comprise the fields of astronomy, chemistry, physics, and physical sciences not elsewhere classified. Examples of disciplines under each of these fields are as follows:

Astronomy: laboratory astrophysics; optical astronomy; radio astronomy; theoretical astrophysics; X-ray, Gamma-ray, neutrino astronomy.

Chemistry: inorganic; organo-metallic; organic; physical.

Physics: acoustics; atomic and molecular; condensed matter; elementary particle; nuclear structure; optics; plasma.

Physical sciences, n.e.c.[1]

d. **Environmental sciences** (terrestrial and extraterrestrial) are concerned (with one exception) with the gross nonbiological properties of the areas of the solar system that directly or indirectly affect man's survival and welfare; they comprise the

[1]Not elsewhere classified. Includes multiciplinary projects within a broad field and single-discipline projects for which a separate field has not been assigned.

fields of atmospheric sciences, geological sciences, oceanography, and environmental sciences not elsewhere classified. The one exception is that obligations for sciences pertaining to life in the sea, or other bodies of water, are reported as support of oceanography and not biology. Examples of disciplines under each of these fields are as follows:

Atmospheric sciences: aeronomy; solar; weather modification; extraterrestrial atmospheres; meteorology.

Geological sciences: engineering geophysics; general geology; geodesy and gravity; geomagnetism; hydrology; inorganic geochemistry; isotopic geochemistry; organic geochemistry; laboratory geophysics; paleomagnetism; paleontology; physical geography and cartography; seismology; soil sciences.

Oceanography: biological oceanography; chemical oceanography; physical oceanography; marine geophysics.

Environmental sciences, n.e.c.[1]

e. **Mathematics and computer sciences** employ logical reasoning with the aid of symbols and are concerned with the development of methods of operation employing such symbols, and in the case of computer sciences, with the application of such methods to automatic information systems. Examples of disciplines under each of these fields are as follows:

Mathematics: algebra; analysis; applied mathematics; foundations and logic; geometry; numerical analysis; statistics; topology.

Computer sciences: programming languages, computer and information sciences (general); design development, and application of computer capabilities to data storage and manipulation; information sciences and systems; systems analysis.

Mathematics and computer sciences, n.e.c.[1]

f. **Engineering** is concerned with studies directed toward developing engineering principles or toward making specific scientific principles usable in engineering practice. Engineering is divided into eight fields: aeronautical, astronautical, chemical, civil, electrical, mechanical, metallurgy and materials, and engineering not elsewhere classified. Examples of disciplines under each of these fields are as follows:

Aeronautical: aerodynamics.

Astronautical: aerospace; space technology.

Chemical: petroleum; petroleum refining; process.

Civil: architectural; hydraulic, hydrologic; marine; sanitary and environmental; structural; transportation.

Electrical: communication; electronic; power.

Mechanical: engineering mechanics.

Metallurgy and materials: ceramic; mining; textile; welding.

Engineering, n.e.c.[1] agricultural; industrial and management; nuclear; ocean engineering systems.

g. **Social sciences** are directed toward an understanding of the behavior of social institutions and groups and of individuals as members of a group. These sciences include anthropology, economics, political science, sociology, and social sciences not elsewhere classified. Examples of disciplines under each of these fields are as follows:

Anthropology: archaeology; cultural and personality; social and ethnology; applied anthropology.

Economics: econometrics and economic statistics; history of economic thought; international economics; industrial, labor, and agricultural economics; macroeconomics; microeconomics; public finance and fiscal policy; theory; economic systems and development.

Political science: area or regional studies; comparative government; history of political ideas; international relations and law; national political and legal systems; political theory; public administration.

Sociology: comparative and historical; complex organizations; culture and social structure; demography; group interactions, social problems and social welfare; sociological theory.

Social sciences, n.e.c.:[1] linguistics; research in education; research in history; socioeconomic geography; research in law, e.g., attempts to assess the impact on society of legal systems and practices.

h. **Other sciences not elsewhere classified** includes multidisciplinary and interdisciplinary projects that cannot be classified within one of the broad fields of science.

8. geographic distribution of 1980 r&d obligations

a. Ten agencies participated in the survey covering the geographic distribution of obligations for research and development and R&D plant. These 10 agencies accounted for 97 percent of total Federal R&D and R&D plant obligations in 1980. The respondents were the Departments of Agriculture; Commerce; Defense; Energy; Health and Human Services; the Interior; and Transportation; the Environmental Protection Agency; the National Aeronautics and Space Administration; and the National Science Foundation.

b. Data were requested for the "actual" year 1980 in terms of the principal location (State or outlying area) where the work was performed by the prime contractor, grantee, or intramural organization. When this information was not available in their records, the respondents were asked to assign the obligations to the State, outlying area, or office abroad where the headquarters of the U.S. prime contractor, grantee, or intramural organization was located.

c. Obligations were reported for research and development as a combined amount.

d. Specifically omitted from the geographic survey were R&D obligations to foreign performers and obligations for R&D plant used in support of foreign performers. Foreign performer data, by country, are reported in another part of the *Federal Funds* survey.

changes in reporting

Responses from the agencies in this survey, as in the previous ones, reflect revisions of estimates for the latest two years of the previous report, in this case fiscal years 1980 and 1981. Such revision is part of the budgetary cycle. From time to time responses also reflect reappraisals and revisions in classification of various aspects of agencies' R&D programs. When this

occurs, NSF requires the agencies to provide revised prior-year data to maintain consistency and comparability with the most recent concepts.

limitations of the data

Funds for research and development are reported on a 3-year basis comparable with the 1982 budget, upon which the data are based. The respondents have reconciled the data reported here with amounts for research and development provided to OMB for the 1982 budget, as revised. The amounts reported for each year, as already stated, are the obligations or outlays incurred in that year, regardless of when the funds were authorized or received by an agency and regardless of whether or not the funds were identified in the agency's budget specifically for research, development, and/or R&D plant.

Data submitted by the Federal agencies for 1980 are considered to be actual since they represent virtually completed transactions. Amounts reported for 1981 and 1982 are estimates in that they are subject to further appropriation, apportionment, or deferral decisions. The effects of these and other, later actions on 1981 and 1982 outlays and obligations will be reflected in the next report.

Respondent judgment is often necessary in classifying the data. Most agency R&D programs must be separated by agency respondents from other, larger programs because they are not identified as budget line items. R&D programs, once identified, must then be further subdivided into the survey categories: basic research, applied research, development, performers, and fields of science. Over the years, however, the participating agencies have developed increasing skill and consistency in meeting the survey requirements.

Some agencies have not been able to report the full cost of research and development. For example, the headquarters costs of planning and administering R&D programs of the Department of Defense (DOD) (estimated at a fraction of 1 percent of the DOD R&D total) are not included because this agency has stated that identification of the amounts is impracticable.

R&D plant data are also to some extent underreported because of the difficulty encountered by some agencies, particularly DOD and NASA, in identifying and reporting these data. While DOD reports obligations for R&D plant under the construction appropriation, DOD is able to identify only a small portion of the R&D plant support within R&D contracts that are funded from the RDT&E appropriation. NASA cannot separately identify those portions of industrial R&D contracts applicable to R&D plant but subsumes R&D plant data in the R&D data covering industrial performance; R&D plant data for other performing sectors can be and are reported by NASA.

relation to other reports

1. federal support to universities and colleges

NSF conducts a separate survey covering Federal support to individual universities and colleges. This survey is based on data provided by the Federal agencies under the reporting system established by the Committee on Academic Science and Engineering (CASE) of the Federal Council for Science and Technology. The reports resulting from these surveys are entitled *Federal Support to Universities, Colleges, and Selected Nonprofit Institutions* and often are referred to as the CASE reports.

Both the CASE and *Federal Funds* reports provide data on Federal obligations for research and development and R&D plant to universities and colleges and to university-administered FFRDC's. The CASE report, however, is based on obligations of Federal agencies to each individual academic institution, whereas the *Federal Funds* report is concerned with obligations to universities and colleges as a performer *group*. The CASE report additionally includes funds for non-R&D activities, such as science education and nonscience support. Further, the CASE survey is based on reports of only 15 agencies (the Departments of Agriculture; Commerce; Defense; Education; Energy; Health and Human Services; Housing and Urban Development; the Interior; Labor; and Transportation; the Environmental Protection Agency; the National Aeronautics and Space Administration; the National Science Foundation; the Agency for International Development; and the Nuclear Regulatory Commission) whereas the *Federal Funds* survey is composed of obligations of all agencies. The 15 respondents to CASE, however, account for more than 99 percent of total Federal R&D support to universities and colleges and all obligations to university-administered FFRDC's.

The different reporting procedures have led to the reporting of different totals to the CASE and *Federal Funds* surveys, as follows:

a. The obligations for research and development to universities and colleges reported for *Federal Funds* in 1980 amounted to $4,277 million, or $131 million more than the amount reported for CASE.

b. The R&D obligation total for university-administered FFRDC's, as reported to *Federal Funds*, was $1,592 million in 1980, or $156 million less than reported for CASE. For *Federal Funds* $161 million subcontracted by the NASA university-administered Jet Propulsion Laboratory was included in ultimate-performer categories, whereas for CASE the subcontracted amount was included in the R&D obligations to FFRDC's administered by universities.

c. Total R&D plant obligations to universities and colleges reported to the *Federal Funds* survey were $40 million in 1980, or $2 million more than the amount reported to the CASE survey.

d. Total R&D plant obligations to university-administered FFRDC's, as reported to *Federal Funds*, were $426 million in 1980, or $46 million more than reported to CASE.

The following factors should also be considered in comparing the data appearing in the two reports:

For *Federal Funds* each agency includes as part of its obligations the amounts transferred to other agencies for R&D activities. A receiving agency does not report funds transferred from another agency. In the CASE survey, by contrast, the data are reported by the agency that makes the *final* distribution of the funds to a given institution. Thus, for the CASE survey, agencies include funds received from other agencies and exclude funds transferred to

other agencies, the reverse of the *Federal Funds* process. Although such transfers should balance each other out with no resulting changes in total R&D obligations, these reverse reporting practices add to the possibility of differences between the two reports.

The CASE responses are in many cases prepared by different operating units within each agency from those that prepare the *Federal Funds* responses. The CASE data are also collected several months earlier than the *Federal Funds* data. Theoretically these conditions should not add to reporting differences, but in practice differences can arise.

2. special analyses, budget of the united states

In a section of *Special Analyses, Budget of the United States Government*, OMB publishes estimates of obligations and outlays for research, development, and R&D plant. These data, as shown in "Special Analysis K: Research and Development" in the original 1982 budget, did not provide as much detail on character of work and performers as *Federal Funds* data, and they did not include information on fields of science or geographic distribution. The same situation held for the revision of "Special Analysis K."

"Special Analysis K" and *Federal Funds* utilized the same definitions for research and development and for R&D plant. The estimates for research and development published in the two reports are comparable, even through minor differences exist. The comparison between the two reports is as follows:

Total Federal R&D obligations
(Billions of dollars)

	FY 1980	FY 1981	FY 1982
Federal Funds .	$31.7	$35.4	$40.6
Special Analysis K (revised) . .	31.7	35.3	40.6

3. federal r&d funding by budget function: fiscal years 1980-82

NSF published a special report under the above title, providing an analysis of Federal R&D programs by budget function categories. The *Federal Funds*, Volume XXX survey, by contrast, reported on R&D funding by agencies rather than functional categories. The *Federal Funds* report provides obligational data rather than budget authority data, which formed the basis for the function report. The R&D budget authority data for 1980-82 in the function report were based on information provided to OMB by the agencies as background for "Special Analysis K" in the 1982 budget plus revised data, submitted later, embodying budget changes. Further program information was based on budget and budget amendment justification documents of the leading R&D support agencies and information provided directly to NSF by some of the smaller agencies.

4. other reports

a. Agencies may classify their R&D programs for purposes other than those for which the *Federal Funds* survey is conducted. Definitions and guidelines that are suitable to these other purposes may result in information that is not comparable with the data transmitted to NSF for *Federal Funds*.

appendix b

federally funded research and development centers, fiscal years 1980-82

NOTE: Total Federal obligations for R&D and R&D plant support to each FFRDC in fiscal year 1980 is shown in parentheses. The overall total is $4,148,419 th.

department of defense
office of the secretary of defense

Administered by other nonprofit institutions:

Institute for Defense Analyses (IDA), Arlington, Virginia ($13,912 Th.)

department of the navy

Administered by universities and colleges:

Center for Naval Analyses (University of Rochester), Arlington, Virginia ($13,644 Th.)

department of the air force

Administered by universities and colleges:

Lincoln Laboratory (Massachusetts Institute of Technology), Lexington, Massachusetts ($106,417 Th.)

Administered by other nonprofit institutions:

Aerospace Corporation, El Segundo, California ($149,536 Th.)

C³ Division (MITRE Corporation),[1] Bedford, Massachusetts($85,978 Th.)

Project Air Force (RAND Corporation),[2] Santa Monica, California($12,056 Th.)

department of health and human services

national institutes of health

Administered by industrial firms:

Frederick Cancer Research Center (Litton Bionetics, Inc., Litton Industries), Frederick, Maryland ($31,984 Th.)

[1]Only the C³ Division of the MITRE Corporation is reported as an FFRDC. All other agency support to MITRE is reported under "other nonprofit institutions excluding FFRDC's."

[2]Only the Project Air Force portion of the RAND Corporation is reported as an FFRDC. All other agency support to RAND is reported under "nonprofit institutions excluding FFRDC's."

department of energy

Administered by industrial firms:

Bettis Atomic Power Laboratory (Westinghouse Electric Corp.), Pittsburgh, Pennsylvania ($232,596 Th.)

Hanford Engineering Development Laboratory (Westinghouse-Hanford Corp.), Richland, Washington ($228,604 Th.)

Idaho National Engineering Laboratory (EG&G Idaho, Inc.), Idaho Falls, Idaho ($171,452 Th.)

Knolls Atomic Power Laboratory (General Electric Company), Schenectady, New York ($171,876 Th.)

Energy Technology Engineering Center (Rockwell International Corporation), Santa Susana, California ($30,828 Th.)

Mound Laboratory (Monsanto Research Corp.), Miamisburg, Ohio ($12,030 Th.)

Oak Ridge National Laboratory (Union Carbide Corp.), Oak Ridge, Tennessee ($303,493 Th.)

Sandia National Laboratories (Western Electric Co., Inc.-Sandia Corp.), Albuquerque, New Mexico ($447,465 Th.)

Savannah River Laboratory (E.I. duPont de Nemours & Co., Inc.), Aiken, South Carolina ($33,772 Th.)

Administered by universities and colleges:

Ames Laboratory (Iowa State University of Science and Technology), Ames, Iowa ($13,383 Th.)

Argonne National Laboratory (University of Chicago and Argonne Universities Assn.), Argonne, Illinois ($235,307 Th.)

Brookhaven National Laboratory (Associated Universities, Inc.), Upton, Long Island, New York ($182,496 Th.)

E. O. Lawrence Berkeley Laboratory (University of California), Berkeley, California ($125,111 Th.)

E. O. Lawrence Livermore National Laboratory (University of California), Livermore, California ($456,635 Th.)

Fermilab (Universities Research Association, Inc.), Batavia, Illinois ($103,558 Th.)

Los Alamos National Laboratory (University of California), Los Alamos, New Mexico ($388,008 Th.)

Oak Ridge Institute of Nuclear Studies (Oak Ridge Associated Universities), Oak Ridge, Tennessee ($6,158 Th.)

Plasma Physics Laboratory (Princeton University), Princeton, New Jersey ($103,437 Th.)

Stanford Linear Accelerator Center (Stanford University), Stanford, California ($57,737 Th.)

Administered by other nonprofit institutions:

Pacific Northwest Laboratory (Battelle Memorial Institute), Richland, Washington ($106,294 Th.)

Solar Energy Research Institute (Midwest Research Institute), Golden, Colorado ($98,653 Th.)

national aeronautics and space administration

Administered by universities and colleges:

Jet Propulsion Laboratory (California Institute of Technology), Pasadena, California ($161,641 Th.)

national science foundation

Administered by universities and colleges:

Cerro Tololo Inter-American Observatory (Association of Universities for Research in Astronomy, Inc.), La Serena, Chile ($4,555 Th.)

Kitt Peak National Observatory (Association of Universities for Research in Astronomy, Inc.), Tucson, Arizona ($9,830 Th.)

National Astronomy and Ionosphere Center (Cornell University), Arecibo, Puerto Rico ($4,990 Th.)

National Center for Atmospheric Research (University Corporation for Atmospheric Research), Boulder, Colorado ($27,437 Th.)

National Radio Astronomy Observatory (Associated Universities, Inc), Green Bank, West Virginia ($16,191 Th.)

Sacramento Peak Observatory (Association of Universities for Research in Astronomy, Inc.), Sunspot, New Mexico ($1,355 Th.)

appendix c

detailed statistical tables

Detailed Statistical Tables for Volume XXX have been published separately (NSF 81-325). Only tables C-1, C-2, and C-3 are included in this report, pp. 42-47.

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notes

- Estimates for 1982 are based on *The Budget of the United States Government, Fiscal Year 1982* and *Fiscal Year 1982 Budget Revisions, March 1981,* as submitted to Congress by the administration, and do not reflect subsequent appropriations and apportionment actions.

- Details may not add to totals because of rounding.

- Asterisks appearing in lieu of figures indicate that the amounts are less than $50,000 or less than .05 percent.

- The abbreviation "FFRDC's" appearing in statistical tables refers to federally funded research and development centers.

- In tables showing extramural performers, obligations of the Department of Agriculture to agricultural experiment stations are included within obligations to universities and colleges.

- Defense Agencies within the Department of Defense include the Defense Advanced Research Projects Agency, the Defense Nuclear Agency, the Defense Communications Agency, the Defense Mapping Agency, the Defense Logistics Agency, the Uniformed Services University of the Health Sciences, and technical support, Office of the Joint Chiefs of Staff.

- R&D data reported by the National Aeronautics and Space Administration are in terms of budget plan rather than obligations.

- Within the Department of Agriculture the Agricultural Cooperative Service replaces the former Farmer Cooperative Service and the Economics and Statistics Service replaces the Economic Research Service and Statistical Reporting Service.

- The historical tables for Volume XXX, providing data on R&D totals for 1972 through 1981 (C-108 through C-121), are not comparable with totals for those years in appendix tables issued to accompany earlier *Federal Funds* reports. The Department of Defense has made revisions in prior-year data, thus changing totals in all categories.

NOTE: For trend comparisons, use only *Federal Funds for Research and Development, Fiscal Years 1980, 1981, and 1982,* Volume XXX (Detailed Statistical Tables), and *Federal Funds for Research and Development: Fiscal Years 1970-1982* (Detailed Historical Tables). Do not use earlier tables.

TABLE C-1. SUMMARY OF FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT: FISCAL YEARS 1980, 1981, AND 1982

(MILLIONS OF DOLLARS)

ITEM	ACTUAL, 1980	ESTIMATES 1981	% CHG 1980-1981	1982	% CHG 1981-1982
TOTAL OUTLAYS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT	31,881.7	35,276.6	10.6%	39,762.3	12.7%
RESEARCH AND DEVELOPMENT	30,400.1	33,667.8	10.7	38,277.4	13.7
R&D PLANT	1,481.7	1,608.8	8.6	1,484.9	-7.7
TOTAL OBLIGATIONS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT	33,236.1	37,026.0	11.4	42,016.7	13.5
RESEARCH AND DEVELOPMENT	31,680.4	35,360.5	11.6	40,602.0	14.8
PERFORMERS:					
FEDERAL INTRAMURAL 1/	7,929.4	9,017.9	13.7	9,995.8	10.8
INDUSTRIAL FIRMS	14,422.0	16,528.5	14.6	20,350.9	23.1
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	1,408.1	1,452.4	3.2	1,536.3	5.8
UNIVERSITIES AND COLLEGES	4,276.9	4,516.0	5.6	4,777.7	5.8
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	1,591.6	1,725.6	8.4	1,882.7	9.1
OTHER NONPROFIT INSTITUTIONS	1,133.9	1,102.4	-2.8	1,093.0	-.9
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	441.8	522.3	18.2	445.2	-14.8
STATE AND LOCAL GOVERNMENTS	265.5	261.8	-1.4	222.5	-15.0
FOREIGN	211.2	233.5	10.6	298.0	27.6
RESEARCH	11,597.4	12,359.3	6.6	13,533.8	9.5
PERFORMERS:					
FEDERAL INTRAMURAL 1/	3,666.3	3,881.8	5.9	4,194.9	8.1
INDUSTRIAL FIRMS	2,077.6	2,243.1	8.0	2,627.6	17.1
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	311.0	348.1	11.9	403.8	16.0
UNIVERSITIES AND COLLEGES	3,699.1	3,941.2	6.5	4,180.2	6.1
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	851.2	932.1	9.5	1,095.2	17.5
OTHER NONPROFIT INSTITUTIONS	678.5	685.7	1.1	711.2	3.7
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	71.7	68.0	-5.1	63.1	-7.3
STATE AND LOCAL GOVERNMENTS	150.9	150.4	-.3	142.5	-5.3
FOREIGN	91.1	108.9	19.5	115.3	5.8
FIELDS OF SCIENCE:					
LIFE SCIENCES	4,192.3	4,436.0	5.8	4,714.4	6.3
PSYCHOLOGY	199.0	206.0	3.5	228.2	10.8
PHYSICAL SCIENCES	2,000.6	2,233.8	11.7	2,644.1	18.4
ENVIRONMENTAL SCIENCES	1,261.0	1,275.7	1.2	1,377.0	7.9
MATHEMATICS AND COMPUTER SCIENCES	240.9	284.1	17.9	321.8	13.3
ENGINEERING	2,830.1	3,027.1	7.0	3,375.8	11.5
SOCIAL SCIENCES	523.8	517.3	-1.2	485.2	-6.2
OTHER SCIENCES, NEC	349.6	379.4	8.5	387.3	2.1
BASIC RESEARCH	4,688.2	5,036.7	7.4	5,551.0	10.2
PERFORMERS:					
FEDERAL INTRAMURAL 1/	1,193.3	1,289.2	8.0	1,424.2	10.5
INDUSTRIAL FIRMS	326.2	305.5	-6.3	353.6	15.7
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	70.4	80.9	15.0	93.9	16.1
UNIVERSITIES AND COLLEGES	2,322.2	2,524.1	8.7	2,760.9	9.4
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	436.8	488.3	11.8	550.4	12.7
OTHER NONPROFIT INSTITUTIONS	279.8	284.5	1.7	304.7	7.1
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	7.5	7.7	2.4	7.6	-.5
STATE AND LOCAL GOVERNMENTS	23.9	24.8	3.9	27.5	10.7
FOREIGN	28.1	31.7	12.7	28.2	-10.9
FIELDS OF SCIENCE:					
LIFE SCIENCES	2,054.4	2,203.9	7.3	2,407.1	9.2
PSYCHOLOGY	84.2	87.4	3.8	98.3	12.5
PHYSICAL SCIENCES	1,221.7	1,314.4	7.6	1,481.3	12.7
ENVIRONMENTAL SCIENCES	534.2	560.3	4.9	615.9	9.9
MATHEMATICS AND COMPUTER SCIENCES	116.9	138.6	18.5	162.7	17.4
ENGINEERING	465.6	520.0	11.7	611.8	17.7
SOCIAL SCIENCES	147.2	144.5	-1.8	125.1	-13.4
OTHER SCIENCES, NEC	63.9	67.5	5.7	48.7	-27.9
APPLIED RESEARCH	6,909.2	7,322.6	6.0	7,982.9	9.0
PERFORMERS:					
FEDERAL INTRAMURAL 1/	2,472.9	2,592.6	4.8	2,770.7	6.9
INDUSTRIAL FIRMS	1,751.4	1,937.5	10.6	2,274.0	17.4
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	240.7	267.2	11.0	309.9	16.0
UNIVERSITIES AND COLLEGES	1,376.8	1,417.1	2.9	1,419.3	.2
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	414.3	443.8	7.1	544.9	22.8
OTHER NONPROFIT INSTITUTIONS	398.7	401.2	.6	406.5	1.3
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	64.2	60.3	-6.0	55.4	-8.2
STATE AND LOCAL GOVERNMENTS	127.1	125.6	-1.1	115.0	-8.4
FOREIGN	63.1	77.2	22.5	87.1	12.7
FIELDS OF SCIENCE:					
LIFE SCIENCES	2,137.9	2,232.1	4.4	2,307.3	3.4
PSYCHOLOGY	114.8	118.6	3.3	129.9	9.6
PHYSICAL SCIENCES	779.0	919.4	18.0	1,162.8	26.5
ENVIRONMENTAL SCIENCES	726.8	715.4	-1.6	761.1	6.4
MATHEMATICS AND COMPUTER SCIENCES	124.0	145.5	17.3	159.1	9.3
ENGINEERING	2,364.5	2,507.1	6.0	2,760.0	10.2
SOCIAL SCIENCES	376.6	372.9	-1.0	360.2	-3.4
OTHER SCIENCES, NEC	285.7	311.8	9.2	338.6	8.6

CONTINUED ON NEXT PAGE

TABLE C-1. SUMMARY OF FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT: FISCAL YEARS 1980, 1981, AND 1982

(MILLIONS OF DOLLARS)

- CONTINUED

ITEM	ACTUAL, 1980	ESTIMATES 1981	% CHG 1980-1981	1982	% CHG 1981-1982
DEVELOPMENT	20,083.0	23,001.2	14.5%	27,068.2	17.7%
PERFORMERS:					
FEDERAL INTRAMURAL 1/	4,263.1	5,136.1	20.5	5,800.9	12.9
INDUSTRIAL FIRMS	12,234.4	14,285.5	15.7	17,723.2	24.1
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	1,097.0	1,104.4	.7	1,132.5	2.5
UNIVERSITIES AND COLLEGES	577.9	574.8	-.5	597.5	4.0
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	740.4	793.4	7.2	787.4	-.8
OTHER NONPROFIT INSTITUTIONS	455.4	416.8	-8.5	381.8	-8.4
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	370.1	454.3	22.7	382.1	-15.9
STATE AND LOCAL GOVERNMENTS	114.6	111.4	-2.8	79.9	-28.2
FOREIGN	120.1	124.6	3.8	182.7	46.6
R&D PLANT	1,555.7	1,665.6	7.1	1,414.7	-15.1
PERFORMERS SUPPORTED:					
FEDERAL INTRAMURAL	491.1	439.4	-10.5	493.5	12.3
INDUSTRIAL FIRMS	304.0	430.7	41.6	185.4	-57.0
FFRDCS ADMINISTERED BY INDUSTRIAL FIRMS	256.0	293.2	14.5	271.8	-7.3
UNIVERSITIES AND COLLEGES	40.3	30.0	-25.5	32.9	9.6
FFRDCS ADMINISTERED BY UNIVERSITIES AND COLLEGES	426.3	394.2	-7.5	418.2	6.1
OTHER NONPROFIT INSTITUTIONS	8.6	4.7	-45.0	3.9	-16.9
FFRDCS ADMINISTERED BY NONPROFIT INSTITUTIONS	24.6	18.4	-25.2	4.7	-74.7
STATE AND LOCAL GOVERNMENTS	.8	.0	-100.0	.0	N/A
FOREIGN	3.9	54.9	1318.6	4.4	-92.1

1/ COSTS ASSOCIATED WITH THE ADMINISTRATION OF INTRAMURAL AND EXTRAMURAL PROGRAMS ARE COVERED AS WELL AS ACTUAL INTRAMURAL PERFORMANCE.

SOURCE: NATIONAL SCIENCE FOUNDATION

TABLE C-2. FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT, BY AGENCY: FISCAL YEARS 1980, 1981, AND 1982

(MILLIONS OF DOLLARS)

AGENCY AND SUBDIVISION	OBLIGATIONS			OUTLAYS		
	1980	ESTIMATES 1981	ESTIMATES 1982	1980	ESTIMATES 1981	ESTIMATES 1982
TOTAL, ALL AGENCIES	33,236.1	37,026.0	42,016.7	31,881.7	35,276.6	39,762.3
DEPARTMENTS						
DEPARTMENT OF AGRICULTURE, TOTAL	744.5	796.9	889.2	687.6	799.4	875.9
AGRICULTURAL COOPERATIVE SERVICE	1.6	2.5	2.5	1.6	2.5	2.5
AGRICULTURAL MARKETING SERVICE	1.3	1.4	1.4	1.3	1.4	1.4
ECONOMICS & STATISTICS SERVICE	31.1	36.6	39.0	31.1	36.6	39.0
FOREST SERVICE	115.2	125.4	135.8	100.6	113.4	135.5
OFFICE OF INTERNATIONAL COOPERATION AND DEVELOPMENT	5.3	5.9	6.7	6.4	6.5	6.7
OFFICE OF TRANSPORTATION	.8	.8	1.1	.8	.8	1.1
SCIENCE & EDUCATION ADMINISTRATION	589.3	624.3	702.7	545.8	638.1	689.8
AGRICULTURAL RESEARCH	405.0	423.4	468.5	371.6	437.0	461.2
AGRICULTURAL COOPERATIVE RESEARCH	184.2	200.9	234.2	174.2	201.2	228.6
DEPARTMENT OF COMMERCE, TOTAL	347.2	337.7	297.6	360.6	360.2	332.2
BUREAU OF THE CENSUS	3.2	3.6	3.8	3.2	3.6	3.7
ECONOMIC DEVELOPMENT ADMINISTRATION	32.3	24.2	-	35.5	29.2	7.8
MARITIME ADMINISTRATION	19.9	15.8	14.3	24.1	17.8	15.9
NATIONAL BUREAU OF STANDARDS	76.4	83.6	103.0	77.1	83.4	99.1
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION	203.6	198.1	165.4	210.6	215.0	195.3
NATIONAL TELECOMMUNICATIONS & INFORMATION ADMIN	10.7	11.2	10.4	9.1	9.9	9.7
OFFICE OF THE SECRETARY	.6	.1	-	.6	.3	.2
PATENT AND TRADEMARK OFFICE	.5	1.1	.6	.5	1.1	.6
DEPARTMENT OF DEFENSE, TOTAL	14,189.2	17,099.7	21,801.0	13,706.1	15,845.3	19,878.7
DEPARTMENT OF THE ARMY	2,993.8	3,306.1	4,046.5	2,852.9	3,145.1	3,722.3
MILITARY FUNCTIONS	2,964.0	3,276.0	4,013.4	2,823.1	3,115.1	3,689.3
MILITARY CONSTRUCTION	10.7	11.4	23.2	5.7	5.1	9.2
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	110.4	136.0	137.1	110.4	136.0	137.1
RDT&E APPROPRIATION	2,842.9	3,128.6	3,853.2	2,707.0	2,974.0	3,543.0
CIVIL FUNCTIONS (CORPS OF ENGINEERS)	29.8	30.0	33.1	29.8	30.0	33.1
DEPARTMENT OF THE NAVY	4,789.3	5,161.9	6,178.2	4,507.9	5,082.7	5,539.1
MILITARY CONSTRUCTION	19.2	24.1	28.8	27.9	12.2	14.1
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	95.9	117.7	125.5	95.9	117.7	125.5
RDT&E APPROPRIATION	4,666.4	5,011.6	6,021.0	4,381.5	4,950.0	5,493.0
SPECIAL FOREIGN CURRENCY PROGRAM	7.8	8.5	2.9	2.6	2.8	6.5
DEPARTMENT OF THE AIR FORCE	5,319.0	7,312.5	9,668.5	5,323.6	6,393.5	8,372.2
MILITARY CONSTRUCTION	46.0	52.0	60.0	46.0	46.0	48.0
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	261.0	335.5	349.2	261.0	335.5	349.2
RDT&E APPROPRIATION	5,012.0	6,925.0	9,259.3	5,016.6	6,012.0	8,475.0
DEFENSE AGENCIES	1,049.2	1,282.3	1,858.7	981.4	1,185.0	1,601.3
MILITARY CONSTRUCTION	-	-	.5	-	-	-
DIRECTOR OF TEST & EVALUATION, DEFENSE	37.9	37.0	49.0	40.4	39.0	44.0
DEPARTMENT OF EDUCATION, TOTAL	139.4	137.2	95.9	120.9	134.2	101.6
DEPARTMENT OF ENERGY	5,777.8	6,111.0	5,547.7	5,660.2	6,104.5	5,815.1
DEPARTMENT OF HEALTH AND HUMAN SERVICES, TOTAL	3,810.8	3,946.9	4,220.8	3,554.1	3,717.4	3,947.0
ALCOHOL, DRUG ABUSE & MENTAL HEALTH ADMINISTRATION	233.5	239.1	261.4	218.1	218.4	215.8
CENTERS FOR DISEASE CONTROL	87.3	80.8	77.2	72.6	79.1	73.2
FOOD & DRUG ADMINISTRATION	76.6	77.9	110.4	61.0	61.9	64.5
HEALTH CARE FINANCING ADMINISTRATION	45.7	46.0	46.0	29.4	45.7	46.0
HEALTH RESOURCES ADMINISTRATION	5.1	5.2	-	2.8	3.7	3.9
HEALTH SERVICES ADMINISTRATION	26.7	13.0	1.1	20.2	13.5	1.1
NATIONAL INSTITUTES OF HEALTH	3,211.2	3,362.1	3,586.6	3,029.3	3,178.7	3,431.4
OFFICE OF ASSISTANT SECRETARY FOR HEALTH	29.9	35.7	21.5	27.0	27.3	24.3
OFFICE OF HUMAN DEVELOPMENT SERVICES	49.3	44.8	71.7	48.5	46.8	46.3
OFFICE OF THE SECRETARY	24.0	22.0	16.7	24.0	22.0	16.7
SOCIAL SECURITY ADMINISTRATION	21.4	20.2	28.3	21.4	20.2	23.2
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT	56.0	51.3	51.4	65.8	58.1	46.4

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TABLE C-2. FEDERAL FUNDS FOR RESEARCH, DEVELOPMENT, AND R&D PLANT, BY AGENCY: FISCAL YEARS 1980, 1981, AND 1982

(MILLIONS OF DOLLARS)

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AGENCY AND SUBDIVISION	OBLIGATIONS			OUTLAYS		
	1980	ESTIMATES		1980	ESTIMATES	
		1981	1982		1981	1982
DEPARTMENT OF THE INTERIOR, TOTAL	418.8	428.3	398.4	431.5	432.4	394.9
BUREAU OF LAND MANAGEMENT	1.7	1.9	2.0	1.7	1.9	2.0
BUREAU OF MINES	114.4	112.7	107.7	130.8	127.4	106.8
GEOLOGICAL SURVEY	146.3	164.3	175.4	145.2	153.8	171.2
NATIONAL PARK SERVICE	8.2	10.0	13.4	8.2	10.0	13.4
OFFICE OF THE SECRETARY	2.2	3.9	1.0	1.9	3.0	1.4
OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT	7.8	6.3	1.2	7.8	6.3	1.2
OFFICE OF WATER RESEARCH & TECHNOLOGY	30.0	20.2	-	30.3	20.2	-
UNITED STATES FISH AND WILDLIFE SERVICE	94.1	94.4	88.2	93.0	92.9	89.4
WATER AND POWER RESOURCES SERVICE	14.1	14.7	9.6	13.1	17.0	9.6
DEPARTMENT OF JUSTICE, TOTAL	41.5	34.2	26.2	45.3	41.7	34.0
DRUG ENFORCEMENT ADMINISTRATION	2.7	2.4	1.8	4.4	3.7	2.0
FEDERAL BUREAU OF INVESTIGATION	1.4	.3	1.1	1.8	1.4	.6
FEDERAL PRISON SYSTEM	2.1	3.1	3.1	2.1	3.1	2.1
IMMIGRATION AND NATURALIZATION SERVICE	.3	1.0	.5	.3	1.0	.4
OFFICE OF THE ATTORNEY GENERAL	1.8	1.5	1.3	1.6	1.0	1.0
OFFICE OF JUSTICE ASSISTANCE, RESEARCH, AND STATISTICS	33.2	25.8	18.4	35.1	31.5	27.8
DEPARTMENT OF LABOR, TOTAL	138.1	107.6	37.1	137.7	107.2	36.8
BUREAU OF LABOR STATISTICS	.9	.8	.9	.9	.8	.9
EMPLOYMENT STANDARDS ADMINISTRATION	4.9	5.9	4.9	4.7	5.7	4.7
EMPLOYMENT AND TRAINING ADMINISTRATION	121.7	88.8	18.9	121.7	88.8	18.9
LABOR-MANAGEMENT SERVICES ADMINISTRATION	2.8	3.1	3.1	2.8	3.0	3.1
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	6.3	8.0	8.3	6.3	8.0	8.3
OFFICE OF THE SECRETARY	1.4	1.0	1.1	1.3	.9	1.0
DEPARTMENT OF STATE, TOTAL	2.2	1.9	1.8	2.2	1.9	1.8
DEPARTMENTAL FUNDS	2.2	1.9	1.8	2.2	1.9	1.8
DEPARTMENT OF TRANSPORTATION, TOTAL	384.5	415.0	421.8	391.0	393.8	380.5
COAST GUARD	18.0	25.0	30.0	17.9	25.0	30.0
FEDERAL AVIATION ADMINISTRATION	108.8	125.0	128.4	109.7	129.2	114.6
FEDERAL HIGHWAY ADMINISTRATION	58.3	56.0	56.1	53.4	53.2	51.2
FEDERAL RAILROAD ADMINISTRATION	56.4	59.5	50.4	63.5	45.1	44.9
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION	63.8	67.9	72.1	60.3	62.2	65.7
OFFICE OF THE SECRETARY	10.8	10.7	10.7	14.9	14.0	10.8
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION	14.0	14.9	16.4	12.4	12.6	12.5
URBAN MASS TRANSPORTATION ADMINISTRATION	54.4	56.0	57.8	58.9	52.5	50.8
DEPARTMENT OF THE TREASURY, TOTAL	12.1	13.3	14.0	10.9	13.1	14.1
BUREAU OF ALCOHOL, TOBACCO, AND FIREARMS	1.6	.3	-	1.6	.3	-
BUREAU OF ENGRAVING AND PRINTING	2.3	4.5	4.7	2.3	4.5	4.7
CUSTOMS SERVICE	3.9	3.7	3.4	3.0	3.3	3.3
INTERNAL REVENUE SERVICE	4.0	4.7	5.8	4.0	4.7	5.8
OFFICE OF PROTECTIVE RESEARCH	.4	.1	.2	*	.3	.3
OTHER AGENCIES						
ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS	2.2	1.8	2.0	1.7	2.1	2.0
APPALACHIAN REGIONAL COMMISSION	.8	.4	.4	.8	.4	.4
COMMUNITY SERVICES ADMINISTRATION	30.3	14.6	-	25.5	22.5	7.3
CONSUMER PRODUCT SAFETY COMMISSION	6.2	6.9	5.4	6.3	6.8	5.6
ENVIRONMENTAL PROTECTION AGENCY	345.0	363.1	302.6	384.7	343.7	327.2
FEDERAL COMMUNICATIONS COMMISSION	3.4	2.7	1.9	3.1	2.8	2.0
FEDERAL EMERGENCY MANAGEMENT AGENCY	11.8	15.1	17.9	11.2	14.3	17.0
FEDERAL HOME LOAN BANK BOARD	1.2	1.2	1.3	1.2	1.2	1.3
FEDERAL TRADE COMMISSION	3.0	4.2	4.4	3.2	4.4	1.8
GENERAL SERVICES ADMINISTRATION	.2	.4	.1	.2	.4	.1
INTERNATIONAL COMMUNICATION AGENCY	.1	.3	.2	.1	.2	.2
INTERNATIONAL DEVELOPMENT COOPERATION AGENCY	155.6	135.6	158.7	114.3	168.3	163.1
AGENCY FOR INTERNATIONAL DEVELOPMENT	155.6	135.6	158.7	114.3	168.3	163.1
INTERSTATE COMMERCE COMMISSION	.1	.2	.2	.1	.2	.2
LIBRARY OF CONGRESS	6.9	6.2	6.6	6.5	7.2	6.6
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	5,243.2	5,522.7	6,122.2	4,851.6	5,274.0	5,395.2
NATIONAL SCIENCE FOUNDATION	900.5	951.8	1,019.7	848.2	909.1	920.1
NUCLEAR REGULATORY COMMISSION	190.4	216.2	231.9	182.8	207.5	222.7
OFFICE OF PERSONNEL MANAGEMENT	6.8	8.5	5.0	6.8	8.5	5.0
SMITHSONIAN INSTITUTION	41.9	45.9	51.4	39.5	43.9	48.7
TENNESSEE VALLEY AUTHORITY	80.7	91.4	96.4	75.3	98.7	112.4
UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY	3.8	1.5	2.2	3.8	1.5	2.2
UNITED STATES INTERNATIONAL TRADE COMMISSION	2.1	3.0	3.9	2.1	3.0	3.9
VETERANS ADMINISTRATION	137.8	151.7	179.6	138.6	146.9	158.3

* INDICATES AMOUNT LESS THAN $50,000.

SOURCE: NATIONAL SCIENCE FOUNDATION

TABLE C-3. FEDERAL FUNDS FOR TOTAL RESEARCH AND DEVELOPMENT, BY AGENCY: FISCAL YEARS 1980, 1981, AND 1982

(MILLIONS OF DOLLARS)

AGENCY AND SUBDIVISION	OBLIGATIONS			OUTLAYS		
	1980	ESTIMATES 1981	ESTIMATES 1982	1980	ESTIMATES 1981	ESTIMATES 1982
TOTAL, ALL AGENCIES	31,680.4	35,360.5	40,602.0	30,400.1	33,667.8	38,277.4
DEPARTMENTS						
DEPARTMENT OF AGRICULTURE, TOTAL	687.6	770.3	860.0	659.8	748.6	844.3
AGRICULTURAL COOPERATIVE SERVICE	1.6	2.5	2.5	1.6	2.5	2.5
AGRICULTURAL MARKETING SERVICE	1.3	1.4	1.4	1.3	1.4	1.4
ECONOMICS & STATISTICS SERVICE	31.1	36.6	39.0	31.1	36.6	39.0
FOREST SERVICE	111.5	122.2	134.3	97.0	110.2	134.1
OFFICE OF INTERNATIONAL COOPERATION AND DEVELOPMENT	5.3	5.9	6.7	6.4	6.5	6.7
OFFICE OF TRANSPORTATION	.8	.8	1.1	.8	.8	1.1
SCIENCE & EDUCATION ADMINISTRATION	536.0	600.9	675.1	521.7	590.6	659.5
AGRICULTURAL RESEARCH	351.8	400.0	440.9	347.5	389.4	430.9
AGRICULTURAL COOPERATIVE RESEARCH	184.2	200.9	234.2	174.2	201.2	228.6
DEPARTMENT OF COMMERCE, TOTAL	342.5	336.8	288.0	355.9	358.9	326.3
BUREAU OF THE CENSUS	3.2	3.6	3.8	3.2	3.6	3.7
ECONOMIC DEVELOPMENT ADMINISTRATION	32.3	24.2	-	35.5	29.2	7.3
MARITIME ADMINISTRATION	19.4	15.8	14.3	23.5	17.4	15.9
NATIONAL BUREAU OF STANDARDS	76.2	83.0	93.5	76.8	82.8	93.2
NATIONAL OCEANIC & ATMOSPHERIC ADMINISTRATION	199.8	197.8	165.4	206.7	214.7	195.3
NATIONAL TELECOMMUNICATIONS & INFORMATION ADMIN	10.7	11.2	10.4	9.1	9.9	9.7
OFFICE OF THE SECRETARY	.6	.1	-	.6	.3	.2
PATENT AND TRADEMARK OFFICE	.5	1.1	.6	.5	1.1	.6
DEPARTMENT OF DEFENSE, TOTAL	13,981.0	16,864.1	21,523.2	13,501.4	15,635.3	19,649.8
DEPARTMENT OF THE ARMY	2,980.0	3,291.0	4,020.3	2,845.3	3,138.2	3,712.2
MILITARY FUNCTIONS	2,950.2	3,260.9	3,987.2	2,815.5	3,108.2	3,679.2
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	110.4	136.0	137.1	110.4	136.0	137.1
RDT&E APPROPRIATION	2,839.8	3,124.9	3,850.2	2,705.1	2,972.2	3,542.1
CIVIL FUNCTIONS (CORPS OF ENGINEERS)	29.8	30.0	33.1	29.8	30.0	33.1
DEPARTMENT OF THE NAVY	4,706.1	5,061.8	6,057.6	4,417.0	4,995.5	5,534.2
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	95.9	117.7	125.5	95.9	117.7	125.5
RDT&E APPROPRIATION	4,602.4	4,935.6	5,929.2	4,318.5	4,875.0	5,402.2
SPECIAL FOREIGN CURRENCY PROGRAM	7.8	8.5	2.9	2.6	2.8	6.5
DEPARTMENT OF THE AIR FORCE	5,211.0	7,196.0	9,542.4	5,220.6	6,281.5	8,763.2
PAY & ALLOWANCES OF MILITARY PERSONNEL IN R&D	261.0	335.5	349.2	261.0	335.5	349.2
RDT&E APPROPRIATION	4,950.0	6,860.5	9,193.2	4,959.6	5,946.0	8,414.0
DEFENSE AGENCIES	1,046.0	1,278.4	1,853.8	978.2	1,181.1	1,596.1
DIRECTOR OF TEST & EVALUATION, DEFENSE	37.9	37.0	49.0	40.4	39.0	44.3
DEPARTMENT OF EDUCATION, TOTAL	139.4	137.2	95.9	120.9	134.2	101.6
DEPARTMENT OF ENERGY	4,753.7	4,926.7	4,690.2	4,697.5	5,011.5	4,858.0
DEPARTMENT OF HEALTH AND HUMAN SERVICES, TOTAL	3,780.2	3,904.8	4,168.6	3,477.2	3,676.7	3,903.9
ALCOHOL, DRUG ABUSE & MENTAL HEALTH ADMINISTRATION	233.5	233.7	260.0	217.9	217.4	214.5
CENTERS FOR DISEASE CONTROL	87.3	90.8	77.1	72.6	79.1	73.2
FOOD & DRUG ADMINISTRATION	75.4	74.9	75.4	60.3	59.9	60.3
HEALTH CARE FINANCING ADMINISTRATION	45.7	46.0	46.0	29.4	45.7	46.0
HEALTH RESOURCES ADMINISTRATION	5.1	5.2	-	2.8	3.7	3.8
HEALTH SERVICES ADMINISTRATION	26.7	13.0	1.1	20.2	13.5	1.1
NATIONAL INSTITUTES OF HEALTH	3,181.8	3,328.3	3,570.8	2,953.2	3,140.9	3,394.0
OFFICE OF ASSISTANT SECRETARY FOR HEALTH	29.9	35.7	21.5	27.0	27.3	24.8
OFFICE OF HUMAN DEVELOPMENT SERVICES	49.3	44.8	71.7	48.5	46.8	46.3
OFFICE OF THE SECRETARY	24.0	22.0	16.7	24.0	22.0	16.7
SOCIAL SECURITY ADMINISTRATION	21.4	20.2	28.3	21.4	20.2	23.2
DEPARTMENT OF HOUSING AND URBAN DEVELOPMENT	56.0	51.3	51.4	65.8	58.1	46.4

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TABLE C-3. FEDERAL FUNDS FOR TOTAL RESEARCH AND DEVELOPMENT, BY AGENCY: FISCAL YEARS 1980, 1981, AND 1982

(MILLIONS OF DOLLARS)

- CONTINUED

AGENCY AND SUBDIVISION	OBLIGATIONS			OUTLAYS		
	1980	ESTIMATES		1980	ESTIMATES	
		1981	1982		1981	1982
DEPARTMENT OF THE INTERIOR, TOTAL	411.3	422.9	397.8	422.7	428.6	394.2
BUREAU OF LAND MANAGEMENT	1.7	1.9	2.0	1.7	1.9	2.0
BUREAU OF MINES	113.4	110.7	107.7	128.4	126.8	106.8
GEOLOGICAL SURVEY	146.3	164.3	175.4	145.2	153.8	171.2
NATIONAL PARK SERVICE	8.2	10.0	13.4	8.2	10.0	13.4
OFFICE OF THE SECRETARY	2.2	3.9	1.0	1.9	3.0	1.4
OFFICE OF SURFACE MINING RECLAMATION AND ENFORCEMENT	7.5	6.3	1.2	7.5	6.3	1.2
OFFICE OF WATER RESEARCH & TECHNOLOGY	29.3	19.1	-	29.3	19.1	-
UNITED STATES FISH AND WILDLIFE SERVICE	88.6	92.1	87.6	87.7	90.8	88.7
WATER AND POWER RESOURCES SERVICE	14.1	14.7	9.6	13.1	17.0	9.6
DEPARTMENT OF JUSTICE, TOTAL	41.5	34.2	26.2	45.3	41.7	34.0
DRUG ENFORCEMENT ADMINISTRATION	2.7	2.4	1.8	4.4	3.7	2.0
FEDERAL BUREAU OF INVESTIGATION	1.4	.3	1.1	1.8	1.4	.5
FEDERAL PRISON SYSTEM	2.1	3.1	3.1	2.1	3.1	2.1
IMMIGRATION AND NATURALIZATION SERVICE	.3	1.0	.5	.3	1.0	.4
OFFICE OF THE ATTORNEY GENERAL	1.8	1.5	1.3	1.6	1.0	1.0
OFFICE OF JUSTICE ASSISTANCE, RESEARCH, AND STATISTICS	33.2	25.8	18.4	35.1	31.5	27.8
DEPARTMENT OF LABOR, TOTAL	138.1	107.6	37.1	137.7	107.2	36.8
BUREAU OF LABOR STATISTICS	.9	.8	.9	.9	.8	.9
EMPLOYMENT STANDARDS ADMINISTRATION	4.9	5.9	4.9	4.7	5.7	4.7
EMPLOYMENT AND TRAINING ADMINISTRATION	121.7	88.8	18.9	121.7	88.8	18.9
LABOR-MANAGEMENT SERVICES ADMINISTRATION	2.8	3.1	3.1	2.8	3.0	3.1
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION	6.3	8.0	8 -	6.3	8.0	8.3
OFFICE OF THE SECRETARY	1.4	1.0	1.1	1.3	.9	1.0
DEPARTMENT OF STATE, TOTAL	2.2	1.9	1.8	2.2	1.9	1.8
DEPARTMENTAL FUNDS	2.2	1.9	1.8	2.2	1.9	1.8
DEPARTMENT OF TRANSPORTATION, TOTAL	361.2	399.4	404.0	374.7	378.6	361.3
COAST GUARD	18.0	25.0	30.0	17.9	25.0	30.0
FEDERAL AVIATION ADMINISTRATION	103.1	120.1	120.9	104.2	121.5	107.4
FEDERAL HIGHWAY ADMINISTRATION	51.1	55.8	55.8	53.1	53.1	51.1
FEDERAL RAILROAD ADMINISTRATION	46.2	49.5	41.0	53.2	38.2	33.6
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION	63.6	67.4	71.5	60.1	61.7	65.1
OFFICE OF THE SECRETARY	10.8	10.7	10.7	14.9	14.0	10.3
RESEARCH AND SPECIAL PROGRAMS ADMINISTRATION	14.0	14.9	16.4	12.4	12.6	12.5
URBAN MASS TRANSPORTATION ADMINISTRATION	54.4	56.0	57.8	58.9	52.5	50.3
DEPARTMENT OF THE TREASURY, TOTAL	12.0	13.2	14.0	10.9	13.0	14.0
BUREAU OF ALCOHOL, TOBACCO, AND FIREARMS	1.6	.3	-	1.6	.3	-
BUREAU OF ENGRAVING AND PRINTING	2.3	4.5	4.7	2.3	4.5	4.7
CUSTOMS SERVICE	3.8	3.6	3.3	3.0	3.2	3.2
INTERNAL REVENUE SERVICE	4.0	4.7	5.8	4.0	4.7	5.8
OFFICE OF PROTECTIVE RESEARCH	.4	.1	.2	*	.3	.3
OTHER AGENCIES						
ADVISORY COMMISSION ON INTERGOVERNMENTAL RELATIONS	2.2	1.8	2.0	1.7	2.1	2.0
APPALACHIAN REGIONAL COMMISSION	.8	.4	.4	.8	.4	.4
COMMUNITY SERVICES ADMINISTRATION	30.3	14.6	-	25.5	22.5	7.3
CONSUMER PRODUCT SAFETY COMMISSION	3.5	4.2	3.3	3.6	4.1	3.5
ENVIRONMENTAL PROTECTION AGENCY	345.0	363.1	302.6	384.7	343.7	327.2
FEDERAL COMMUNICATIONS COMMISSION	3.4	2.7	1.9	3.1	2.8	2.0
FEDERAL EMERGENCY MANAGEMENT AGENCY	11.8	15.1	17.9	11.2	14.3	17.0
FEDERAL HOME LOAN BANK BOARD	1.2	1.2	1.3	1.2	1.2	1.3
FEDERAL TRADE COMMISSION	3.0	4.2	4.4	3.2	4.4	1.9
GENERAL SERVICES ADMINISTRATION	.2	.4	.1	.2	.4	.1
INTERNATIONAL COMMUNICATION AGENCY	.1	.3	.2	.1	.2	.2
INTERNATIONAL DEVELOPMENT COOPERATION AGENCY	149.3	127.9	151.2	107.8	161.5	155.4
AGENCY FOR INTERNATIONAL DEVELOPMENT	149.3	127.9	151.2	107.8	161.5	155.4
INTERSTATE COMMERCE COMMISSION	.1	.2	.2	.1	.2	.2
LIBRARY OF CONGRESS	6.9	6.2	6.6	6.5	7.2	6.6
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION	5,084.1	5,407.7	6,017.4	4,711.3	5,117.6	5,741.7
NATIONAL SCIENCE FOUNDATION	881.8	937.4	999.9	830.6	896.3	903.8
NUCLEAR REGULATORY COMMISSION	182.7	207.7	224.5	175.4	199.4	215.6
OFFICE OF PERSONNEL MANAGEMENT	6.8	8.5	5.0	6.8	8.5	5.0
SMITHSONIAN INSTITUTION	41.0	45.2	50.5	39.1	43.1	48.0
TENNESSEE VALLEY AUTHORITY	80.1	91.1	95.5	74.7	98.4	111.5
UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY	3.8	1.5	2.2	3.8	1.5	2.2
UNITED STATES INTERNATIONAL TRADE COMMISSION	2.1	3.0	3.9	2.1	3.0	3.9
VETERANS ADMINISTRATION	133.4	145.9	152.9	134.4	140.5	148.3

* INDICATES AMOUNT LESS THAN $50,000.

SOURCE: NATIONAL SCIENCE FOUNDATION